

FLIGHT

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AND AIRSHIPS

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Founder and Editor: STANLEY SPOONER

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EDITORIAL COMMENT

BLOCK in promotion in a fighting Service is a serious matter. It inflicts hardship on a number of officers, and this must in turn have a prejudicial effect on applications for commissions. Of late a good deal has been heard of the hardships of Group Captains who have had to go on the Half-Pay or Retired Lists when they desired to continue in active employ. Something has to be done to remedy such a state of affairs. In this case the Chief of the Air Staff has set an example by relinquishing his appointment long before he might have been expected to go into unemployment. His unselfish action raises the reflections that no such consideration weighed with his predecessor, and that the Royal Air Force can spare a number of Group Captains more easily than it can spare Sir John Salmond. This act only creates one vacancy in each rank below him. Presumably one Air Marshal, one Air Vice-Marshal, one Air Commodore, one Group Captain, one Wing Commander, one Squadron Leader, one Flight Lieutenant and one Flying Officer will get promotion as a result of the disappearance of Sir John, and one feels inclined to ask whether the benefits to these seven men will compensate for the loss to the Service of a brilliant personality and intellect. On the material side, the loss is probably greater than the gain.

None the less, the example set by the supreme head of the Service may well have an effect which will more than compensate for that loss. Sir John has set an example of disinterestedness which will form a precedent for the future. The case of Lord Trenchard was a special case, and ought not to be taken as a precedent. The youth of the Service which he was moulding was an excuse for his long tenure of office of Chief of the Air Staff, and things might not have gone so well if he had retired (we are aware that, strictly speaking, a Marshal of the Royal Air Force never does retire) before Sir John Salmond had done his work of starting the air control of Iraq on its way and doing a like service for the Command of Air Defence of Great Britain. Those two tasks

DIARY OF CURRENT AND FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in this list:—

- July 30-31. Skegness Air Pageant.
- July 31. Comrades of the R.A.F. (Hounslow, Heston and Dis. Branch), Garden Party, Hanworth.
- July 31-Aug. 13. National Aviation Day Displays (See p. 715).
- Aug. 1. Motor Rally and Flying Gymkhana, Armthorpe Aerodrome, Doncaster.
- Aug. 6. Newcastle Air Meeting, Cramlington.
- Aug. 6. London-Newcastle Air Race.
- Aug. Cramlington Air Race.
- Aug. 6-7-8. International Air Meeting, Le Zoute, Belgium.
- Aug. 11-28. International Touring Competition, Berlin.
- Aug. 15-16. Cricket: R.N. v. R.A.F. at Lords.
- Aug. 19-21. 4th Annual Canadian Air Pageant, St. Hubert, Quebec.
- Aug. 20. Ryde Air Pageant.
- Aug. 25. Folkestone Aero Trophy Race.
- Sept. 3. Leicester Chamber of Commerce Day, at Desford.
- Sept. 4. Divine Service at Ratcliffe Aerodrome, 2.30 p.m.
- Sept. 5. F.A.I. Conference at The Hague.
- Sept. 8. International Meeting, Vicenza, Italy.
- Sept. 24. Air Display at Hillmans' Aerodrome, Maylands Aerodrome, Brentwood.
- Sept. 25. Gordon Bennett Ballon Race, Basle.
- Oct. 1. Bristol and Wessex Ae.C. Garden Party.
- Oct. 18. Aero Golfing Society: Cellon Challenge Cup, West Hill G.C.
- Nov. 18-Dec. 4. Paris Aero Show.

called for an exceptional man, and until they had been nursed through their teething troubles the destined successor to Lord Trenchard was not ready to take up the work of supreme control. The same argument does not apply now. A suitable successor to Sir John is available, and Sir John is able to relinquish his appointment with full confidence in the future. That consideration, however, only diminishes our regret that circumstances make it advisable for him to go. That he has taken the initiative himself in the interests of his Service, increases the respect which we feel for Sir John.

The history of eminent brothers is a fascinating study in heredity. In modern times in Great Britain, perhaps the most notable case has been that of the Cecil brothers, and the Harmsworths might also be quoted. The Salmonds, however, are unique, for they dealt with a unique and novel problem. They both came from the Army to the Royal Air Force, John from the infantry and Geoffrey from the artillery. They worked separately, and each attained eminence on his own merits. At the end of the war John commanded all the aircraft in Lord Haig's Army in France, and Geoffrey commanded all the aircraft on all the other fronts combined. Since the war John has commanded in Iraq and Geoffrey in India. Both have been on the Air Council and both have commanded Air Defence of Great Britain. Now Geoffrey is to succeed John as Chief of the Air Staff. He comes to this appointment well experienced in command and in organisation. He has proved his ability in many diverse fields. In particular, he has shown more practical interest than most R.A.F. officers have shown in civil air transport. It was he who laid out an air route from Cairo to South Africa before the ink was dry on the Armistice document. As Air Member for Supply and Research he had much to do with forwarding the movement to secure reliability by providing three engines on civil aircraft. That principle may not endure for ever, but at the time it was a move very much in the right direction. We feel that the Royal Air Force is fortunate in having a Salmond to succeed a Salmond.

❖ ❖ ❖ ❖

The Disarmament Conference at Geneva has come to an agreement which at least does credit to its heart. No one wants another war. No one wants the aggressive spirit, the desire to invade and crush

The Geneva Resolution

another nation, to govern the future relations of civilised nations. If, however, another war does come, everyone, except a few very wrong-headed people, wants to prevent the civil population from suffering the worst of its horrors. There are some who urge that if you assure the civilians that they will be safe, you are making war more probable; whereas if you tell them that they will suffer as much as the armed men suffer, they will prevent any war from taking place. Such an argument is utterly unconvincing. If a nation believes that its vital interests are being attacked, it will fight to defend them. It must fight; there is no alternative, unless the League of Nations becomes something very different from what it shows signs of becoming. Then in that case every nation which retains a vestige of civilised spirit must desire that the civil population shall be saved from indiscriminate slaughter. The Disarmament Conference, while piously hoping that it may be possible to pre-

vent all wars, in the meantime has undertaken the very laudable task of trying to diminish the horrors of such wars as cannot be prevented. The question which interests us now is whether those measures are likely to produce the effect which they are intended to produce. In the first place all chemical, bacteriological and incendiary warfare is forbidden. We are in doubts as to whether it was wise to insert the word incendiary. There are cases when it is the obvious right of a belligerent to set a certain building on fire if it is able to do so. The other stipulations must be heartily approved by anyone who is not worse than a barbarous savage. A belligerent may, of course, break this rule and hope to escape the penalty. The recent fate of reparations has set a bad precedent in such matters. None the less, it is good work to make such a rule. Despite popular impressions to the contrary, sensibly-framed rules of war are usually observed by belligerents, and for those who are not restrained by feelings of honour, the fear of reprisals acts as a healthy deterrent.

The resolution passed at Geneva then proceeds to deal with air warfare as such. It absolutely prohibits air attacks against a civil population. This, too, is a very good rule to have passed. There is a world of difference between the accidental killing of civilians, with bombs aimed at a military objective, and deliberate attacks on the civilians themselves. Next it is laid down that all bombardment from the air shall be prohibited, subject to certain detailed regulations. This rule seems to us to forbid too much, and therefore to stand self-condemned.

A rule of war which forbids to a belligerent what are his obvious legitimate rights will never be observed for long. It will be violated in the first days of battle, and its violation will bring no disgrace on those who break the rule. The only reputations which will suffer will be those of the legislators who were so unwise as to make an impossible stipulation. The whole point is the distinction between what is a reasonable and what is an unreasonable rule, and to draw the distinction is not a very difficult matter. No one would dream of forbidding a bayonet fighter to strike below the belt. The production of bombers in peace time may be prevented, but the moment war breaks out each belligerent will set to work to use aircraft to drop bombs on all targets which are beyond the range of the artillery. It would be absurd to expect anything else. Converted passenger machines would certainly make very inefficient bombers, and until rear cockpits had been inserted they would by day be an easy prey for defensive fighters. They could, in fact, only be used at night. The crews would be unpractised in bombing, and so would usually miss the military objectives at which they aimed, and prove a most unwelcome danger to civilians in the neighbourhood. That state of affairs, however, would not last long. Before long true bombers would be produced on both sides, crews would be trained, and things would go on as though no conference had ever sat at Geneva. The most deplorable thing would be that international rules would have been brought into contempt, and those who, quite justifiably, had broken one rule, might be tempted to break another without any justification at all. If Geneva is to do good, enduring work, it must above all things observe the difference between a reasonable and an unreasonable prohibition.

THE PASSING OF A PIONEER

Death of Santos-Dumont



A WIRELESS message from Sao Paulo on July 24 reported the death of M. Alberto Santos-Dumont, at the age of 59. Santos-Dumont, it need hardly be noted, was one of the first pioneers of both the lighter-than-air and the heavier-than-air types of aircraft. The son of a wealthy Brazilian coffee planter of Sao Paulo, he came to Paris in 1891 with the object of studying the problems of motor-car and aerial transport. His first activities in connection with the latter lay in the direction of following up the experiments of Henri Giffard with navigable balloons, and made his first free balloon ascent with Machuron in 1897.

Following this trip Santos-Dumont, in spite of much adverse criticism, set to work to put his theories into practice. He ordered from Lachambre and Machuron an envelope 82½ ft. long by 11½ ft. diameter, to which he added a "car," suspended by a suspension system of his own design, carrying two motor-cycle engines driving a propeller. In this he made his first ascent from the Jardin d'Acclimation on September 18, 1898, but in doing so fouled a tree and damaged the airship.

Repairs having been effected, he made a second attempt a few days later, and this time succeeded in executing a series of manœuvres by means of a vertical rudder and the usual ballast and guide rope as used in free balloons.

These first experiments brought out certain defects—the air pump used for maintaining rigidity of the envelope proving inadequate, resulting in somewhat hasty landings owing to the collapse of the envelope! However, lessons learnt were embodied in "Santos-Dumont" No. 2, which was otherwise much the same as No. 1. The first ascent with No. 2—on May 11, 1899—ended with the same fate that befell No. 1, so Santos-Dumont started work on No. 3, which was 66 ft. long and 25 ft. diameter (17,650 cu. ft.), with a sliding weight for vertical stability, and in November the same year a successful flight was accomplished.

Encouraged by his success, Santos-Dumont then established a works at St. Cloud, and there produced several airships in more or less rapid succession—each an improvement on the one before. In 1901 he made two nearly successful attempts, on No. 5, to win the Deutsch de la Meurthe prize for a flight round the Eiffel Tower, in the

"THE INFURIATED GRASSHOPPER": Santos-Dumont's "Demoiselle" monoplane, first produced in 1908. (FLIGHT Photo.)

first failing to reach home within the specified 30 minutes, and in the second coming to grief on the roof of the Trocadéro.

With his next airship, No. 6, which was 103 ft. long and of 22,239 cu. ft. capacity, and had a motor of 12 h.p., Santos-Dumont succeeded in winning the prize on October 19, 1901. Following this, he built several more airships, on which he accomplished successful "cross-country" flights.

Santos-Dumont now turned his attention to heavier-than-air machines, and in 1905 produced his first aeroplane, No. 13 bis—a weird cellular contrivance, based on the theories of Hargrave. Although it succeeded in making a few short hops, this machine could hardly be recorded as satisfactory, but, nevertheless, Santos-Dumont now became a keen heavier-than-air advocate, and proceeded with his second machine, No. 14 bis, which we show in the accompanying illustration.

On this machine, which was fitted with a 50-h.p. Antoinette engine, Santos-Dumont succeeded in making several short flights in 1906—the first power-driven flights to be made in public in Europe—one at Bagatelle of 8 sec. duration on September 14, another for a distance of 160 ft. on October 23, and three more on November 12 of 200, 270 and 720 ft. By these flights Santos-Dumont won the Archdeacon Prize for the first person in Europe to fly 25 m., and the Aero Club of France Prize for the first flight of 100 m.

His second machine also flew, although not so successfully, but it was in 1908 that he produced his historic "Demoiselle," which was undoubtedly a distinct advance in aeroplane "design" of the period. This first "light plane," which we illustrate, was very lightly constructed, weighing but 260 lb. complete, and frequently "disintegrated" on landing, but, nevertheless, with its 30-h.p. Darracq engine it flew, on the whole, remarkably well—at times about 60 m.p.h.—and later several of these little machines took part in the various early meetings.



Santos-Dumont in his second biplane, "14 bis," on which he made the first public flight in Europe, in 1906. This machine was of the "tail-first" type.

SIR JOHN SALMOND RESIGNS

Sir Geoffrey Salmond Succeeds

THE Air Ministry announces that Air Chief Marshal Sir J. M. Salmond, G.C.B., C.M.G., C.V.O., D.S.O., LL.D., having expressed the desire to resign the appointment of Chief of the Air Staff in order to accelerate promotion in the junior ranks of the Royal Air Force, His Majesty the King has been pleased to approve the nomination of Air Marshal Sir W. G. H. Salmond, K.C.B., K.C.M.G., D.S.O., to succeed him with effect from April 1, 1933.

Air Chief Marshal Sir John Salmond has passed a self-denying ordinance which robs the service of a brilliant officer at a comparative early age. Work in the Royal Air Force may be varied, it may be responsible, and it may be carried out well or badly. As the Service is a new one, some tasks are without precedent, and call for a sort of inventive initiative in the officer first entrusted with them. Sir John Salmond has done all of these things. His appointments have been most varied, and they have been most responsible; while more than one of them has been almost or entirely novel and unprecedented. In every capacity Sir John Salmond has been a brilliant success. On the outbreak of war he was in command of No. 3 Squadron, and when leading that squadron in the field he displayed cool, calculating bravery which would have seemed like recklessness in some others. He did not disregard risks; he summed them up and decided what risks ought to be faced. The Distinguished Service Order was no more than a fitting reward for his fighting services.

The Armistice found him in command of the Royal Air Force in the field, as apart from the Independent Air Force. His command embraced all the aircraft and air organisation which served the Army under the command of Lord Haig. Since then he has been Air Officer Commanding in Iraq, Air Officer Commanding-in-Chief Air Defence of Great Britain, and Chief of the Air Staff. The mere recital of the appointments gives but little idea of the sort of work to be done in each. Iraq was the first instance of the newly-formed Royal Air Force being given the responsibility for the defence of a country, external and internal. The A.O.C. was in command, not only of the units of his own service, but also of all Army units in the country. The whole idea was novel, and Sir John Salmond had to transform the idea into a working fact. It was a big task and called for a big man. There is not the slightest doubt that Sir John's work was very well done and will form a precedent for other cases of "control without occupation." It has been copied on a smaller scale in Palestine, Transjordan and Aden.

The next great task was to start the command Air Defence of Great Britain. Gen. Ashmore had left some precedents there, but a fresh start had to be made, and the new conception of the command was on a much wider scale than the old one had been. A Bombing Area, for example, now plays a part in the scheme, and the Fighting Area is a much more elaborate affair than was the old collection of home defence squadrons. The Observer Corps had to be started afresh and trained on improved methods. Again, so far as the outside student can judge, the work of Sir John will endure. Finally, Sir John rose

to the highest appointment in his Service, that of Chief of the Air Staff. This time he was not the first, but the second, officer to hold this appointment in post-war conditions. Initiation was not so necessary as in his previous appointments, but there was need for adaptations. It had become evident that the number of short-service commissions must be reduced, and the places of the officers who held them must be taken by airmen pilots. Sir John Salmond put this work in hand, and in many other directions he added to the efficiency of the Force of which he had become the supreme chief. Many more years of brilliant work might have been expected from him, but he could rise no higher (except for one step in rank), and now he is paying the last service which he can to the Royal Air Force by sacrificing himself to ease the block in promotion which has been weighing heavily upon that Force.

Salmond to Salmond succeeds. Air Marshal Sir Geoffrey Salmond is the elder brother of Sir John. An old artillery officer, his Army training stood him in good stead when, as staff officer of the R.F.C. in 1914, he grappled with the problem of using aircraft to observe for the guns. Then he raised No. 1 Squadron and took it to France, but his chief war services were performed as Air Officer Commanding the Middle East. As such he was responsible for all air operations in Gallipoli, Salonika, Egypt, Palestine and Iraq.

Never have aircraft more completely justified themselves in war than in the final stages of Allenby's advance in Palestine. The attack had to be a surprise. Its success depended on the Turks being left in complete ignorance of the spot at which the decisive blow would be struck. Therefore their aeroplanes must not be allowed to see anything behind our lines. Fortunately we had the air strength to prevent them. Our "Camels" kept regular patrols over all Turkish aerodromes from dawn to dusk for days before the attack was made, preventing any enemy aeroplanes from taking off. Consequently the Turks were taken completely by surprise, and the cavalry broke through and forced a general retreat. Then the aircraft joined in the pursuit, and bombed the retreating Turkish Eighth Army on the road to Nablus so thoroughly as to cause its complete destruction.

After the Armistice, Sir Geoffrey made the first flight to India in a Handley Page machine with Capt. (later Sir) Ross Smith as pilot. He then proceeded to lay out a chain of aerodromes from Egypt to South Africa, with the intention that the Dark Continent should be traversed by a land-plane and by a flying-boat of the R.A.F. This route was used by Sir Pierre Van Ryneveld and Sir Christopher Brand on their first flight to South Africa, and the present air mail route can be traced to these beginnings.

In 1922 Sir Geoffrey Salmond became Air Member for Supply and Research, and did much to introduce the principle of the three-engined machine for air transport. In 1926 he was appointed to the command of the R.A.F. in India, and flew out to his command in the "Hercules," which also took Sir Samuel and Lady Maude Hoare to India.

Last year Sir Geoffrey returned home to take over the command A.D.G.B. from Sir Edward Ellington.



THE SALMOND BROTHERS: Sir John on the left and Sir Geoffrey on the right. Sir John resigns his appointment as Chief of the Air Staff, and Sir Geoffrey takes his place. (FLIGHT Photo.)

Private Flying and Gliding

AVIATION AT KINETON

A really excellent small flying meeting was run on Saturday, July 23, by the Northamptonshire Aero Club at Lord Willoughby de Broke's aerodrome at Kineton, near Stratford-on-Avon.

Quite a large number of visitors arrived by air, and at one time there must have been fully 25 aircraft present—a very good number for a meeting of this kind. The local populace—no doubt largely due to Lord Willoughby de Broke's regular use of his own aeroplanes—were evidently very interested in flying, with the result that the "gate" was large, the Avros of Messrs. Holmes & Kingwill being well patronised by joy-riders.

The programme opened with a fly-past made as varied as possible by the inclusion of a "Moth," "Spartan 3 Str." (latest model), "Puss Moth," "Klemm," "Swift," "Avro" and "Avian."

Lt. Com. Geoffrey Rodd, R.N., gave a demonstration of his "Puss Moth." This was a particularly finished exhibition of flying, and quite one of the prettiest bits of flying we have seen for a long time. Mr. Rodd is at present engaged in film work.

Besides showing the spectators how controllable the "Puss Moth" is when flown fast, Com. Rodd also demonstrated, very effectively, the slow speed at which this machine could be flown by an experienced pilot, while on landing he gave yet a further demonstration of its practicality by turning on one wheel first one way and then the other, finally parking the machine with the same ease as if it were a motor-car. Capt. Kingwill then flew crazily in a "Mongoose Avro," and, as the programme put it, "showed how an aeroplane ought not to be flown"! Mr. Eaton proved that his accident, when his hand was burnt at the Whit-Monday Sywell meeting, has not impaired his efficiency with a shot-gun, and only one balloon escaped his unerring aim when released from an aircraft somewhat above and in front of him. Mr. Mark Lacayo showed off his Comper "Swift" (Pobjoy) to advantage, and Mr. Palmer, the Northamptonshire Club's instructor, gave an exceedingly safe and sensible aerobatic display. The "Pobjoy" engine was well represented at the meeting, for its musical note was heard coming not only from Mr. Lacayo's "Swift," but also from Mr. A. B. Gibbon's "Klemm." This latter machine is a really phenomenal performer, and Mr. Gibbons has certainly "got it taped." He takes off, after raising his tail slightly with the aid of his brakes, in an incredibly short space, and if there is any wind at all, he seems almost to rise vertically. At Kineton there was very little wind, but even then he was certainly off the ground in less than 20 yards, while at

Brooklands on the following day he actually only ran 49 feet before his wheels left the ground. Being fitted with a self-starter, he was able to make a very effective glide over the aerodrome with his engine stopped before starting up again and coming in to land. Flt. Lt. Johnson threw about Mr. Jack Linnell's "Moth" in his usual efficient fashion. This machine was not fitted for inverted flying, and Flt. Lt. Johnson naturally was somewhat hampered thereby, but nevertheless he made several spectacular inverted glides as well as all the ordinary slow and fast manoeuvres. He came up to the meeting in a "Moth" from the Phillips & Powis School of Flying, which is specially fitted for instrument and night flying, the same which has since been hired to Mrs. Victor Bruce in connection with her record attempt. An aerial golf match proved somewhat harder than was thought, the four holes being placed fairly close together in a straight line across the aerodrome, thus necessitating really good "shooting" on the part of the pilot. Mr. Tyzack was first with a total error of only 35 yards, and Flt. Lt. Johnson with an error of only 47 yards. After this there came a very pretty little formation of club machines, with Mr. G. Linnell at the head, Mr. P. Tyzack on his left hand and Mr. Palmer on his right. The "Prince of Wales' feathers," which concluded their exhibition, was one of the best club manoeuvres we have seen. A display of model aircraft flying followed, and the time some of the accurate scale models stayed in the air was really amazing. By way of a finale, a pseudo-fort, which had been erected in the middle of the aerodrome, was destroyed. The same three club machines which did the formation flying again took part and, despite the fact that one of them was "shot down," thus enabling the pilot (dummy) to take to his somewhat inefficient looking, but characteristically effective, parachute, the others by means of accurate bombing eventually set fire to the fort, greatly to the delight of the many children among the spectators.

BROOKLANDS

Over 70 hr. flying were put in during the week ending July 16, at Brooklands, and there seems every probability that the following weeks' figures will surpass this. Now that the "Moths" of both the College of Aeronautical Engineering Flying Club and Brooklands Flying Club are constantly in use it is expected that these figures will be increased greatly, and although the members of the latter club can only get away late in the evenings or during week-ends, their keenness is so great that a number of them have already been sent solo and are rapidly approaching their "A" licence stage. The aerodrome has been



"STAGE AND SCREEN": The inaugural meeting of the Stage and Screen Aero Club was held at Hatfield Aerodrome on Sunday, July 24. The de Havilland School Clubhouse was the venue. In the foreground is the demonstrator "Puss Moth" of Brian Lewis, Ltd. Flt. Lt. Comper showed off a "Swift" (Gipsy III) during the afternoon.



“UP AND AWAY”: Mr. Brie lifting the “Autogiro” from the ground for a steep climb when competing at Brooklands on Sunday. (FLIGHT Photo.)

used quite a lot during the week by the British International Film Co. for scenes of their new film entitled “The King’s Cup,” the flying side of which is being directed by Lt. Com. P. G. Rodd, R.N. A large number of entries have been received for the blind flying contest. On Sunday, July 24, a very interesting competition was held which was an endeavour to show the relative efficiency of various types of aircraft, also taking into account the efficiency of the pilot. For this competition each competitor had to take off with the shortest possible run, climb to 1,000 ft. in the shortest time, stop his engine and glide down to a mark on the ground, taking as long as possible over his glide, touch the aerodrome as near this mark as possible and land with the shortest run possible. The entrants included Capt. D. Davis on one of his own “Moths” (Gipsy I), Mr. A. B. Gibbons on his “Klemm” (Pobjoy), Mr. R. A. C. Brie on an “Autogiro” (Genet), Mr. J. A. Mollison on his “Puss Moth” (Gipsy III), and Mr. J. E. McClure on his “Woodpigeon” (Anzani). A system of marking was evolved which took into account the distance run in feet, and time taken to glide and climb in seconds, the latter being measured by barograph. It will be seen from the table that Mr. A. B. Gibbons was a very easy winner. This competition, although not so well patronised as had been hoped, created nevertheless quite a large amount of interest among the club members, who turned up in force to witness the efforts of the various participants. We hope that there will be many more competitions like this.

Name.	Take-off.	Landing run.	Glide from 1,000 ft.	Climb to 1,000 ft.	Accuracy (landing) marks.	Score.
	ft.	ft.	min. secs.	min. secs.		
A. B. Gibbons	49	124	2 30	1 15	256	908
R. A. Brie	164	20	1 30	1 35	252	653
Capt. S. Davis	136	211	1 35	1 30	222	490
J. A. Mollison	216	309	1 40	1 43	229	304
J. E. McClure	156	185	2 00	2 55	147	241

ACCIDENTS AT THE WASSERKUPPE

The well-known glider pilot Herr Günther Groenhoff, of Frankfurt, who for some years past has been official pilot at the Wasserkuppe Gliding School of the Rhön Rossitten Ges., was killed on Saturday, July 23, during a flight over the Wasserkuppe. Herr Groenhoff had just taken off in the “Fafnir,” the sailplane upon which he made his record flight of 172 miles from Munich into Czechoslovakia last year, but did not appear to gain full control of the machine. He jumped out at a very low altitude and his head struck a branch of a tree before his parachute had opened properly, killing him instantly.

Earlier in the week Herr Kronfeld had a narrow escape when his enormous sailplane, the “Austria,” crashed from a high altitude. Herr Kronfeld jumped clear and

his parachute functioned satisfactorily. The reason for his abandoning the “Austria” has not yet been published. This machine was illustrated in FLIGHT for July 3, 1931, on the occasion of its visit to Hanworth Park, when Herr Kronfeld made several flights in it over the club. During the same visit he also made an extended flight from Hanworth to Chatham, returning in his “Wien.”

MAIDSTONE AIRPORT

West Malling aerodrome has, as we have already mentioned, been taken over by Land, Air & Water Service, Ltd., and will in future be known as Maidstone Airport. The company will continue to operate the flying school there and both the charges for flying and in the restaurant will be kept as low as possible. The accommodation for the Maidstone Aero Club is being redesigned and will include a swimming pool, squash courts, dormitory, changing room, lounge, large dining room with

dance floor, etc. The company have a high-speed car available should persons who land there wish to carry on to London by road. Customs facilities will be available and every facility will be provided for taxi work.

YORK COUNTY AVIATION CLUB

The York County Aviation Club held a very successful “At Home” on July 23 and 24, quite a large number of private owners turning up from places as far apart as Cramlington and London. A dinner and dance followed during the evening, and Mr. Irving, whose name is well-known in connection with his parachutes, entertained the company with many of his parlour tricks. Mr. Irving is one of the most versatile entertainers we know, and appears to prefer standing on his head when doing such mundane things as drinking a glass of beer or playing the piano! On Sunday the weather, unfortunately, was rather thick and very few visiting aircrafts were able to get through to Bridlington for the bathing picnic which had been arranged. Five aircraft from the club succeeded in reaching the ground, while several others landed near Grindale, from whence they were fetched in motor cars.

READING NOTES

Mr. Heelas went solo with the Phillips & Powis School on Sunday, July 17, and on the Monday the school welcomed back one of their oldest members, Mr. Scott, who has recently returned from a very interesting holiday in Soviet Russia. On Wednesday a “Moth” was sent to Yateley, in connection with the annual village fête, and over 50 persons were taken up for joy rides. The Hon. Mrs. Victor Bruce has been supplied with a “Moth” to form part of the refuelling flight for her endurance record. This is of particular interest, as the machine supplied is the one which has been specially fitted for night and instrument flying, and by its use Mrs. Bruce hopes that contact will be established with her “Windhover” under all conditions. Despite the fact that this “Moth” has full night-flying equipment, as well as blind-flying instruments in each cockpit, its performance is certainly as good as any other “Moth.” This same machine was at Lord Willoughby de Broke’s meeting at Kineton on Saturday, July 23, and in it Flt. Lt. Johnson secured second prize for the aerial golf competition. On returning to Reading, Flt. Lt. Johnson, who, as everyone knows, is the accepted expert on instrument flying, tested out the “hood” which has been devised for this machine in conjunction with the firm’s instructor, Lt. Com. C. W. Croxford, R.N. This hood, being of white canvas, does not have the depressing effect on the pilot, when it is closed, as does the common green Willesden canvas; moreover, it allows a larger percentage of light through, thus making the instruments easier to read. These two pilots were evidently satisfied with the machine, and showed themselves bitten with the fascination of flying by instruments, as after Com. Croxford

had performed under the hood for some considerable time they landed and changed places before going up again for another long spell. The value of instrument flying is almost incalculable; this fact would appear to be realised at Reading, where the number of pupils applying for instruction is steadily on the increase.

SKEGNESS

People wishing to attend the dance to be held on Saturday, July 30, previous to the Skegness Aero Club's pageant, should apply to Eastern Air Transport, Ltd., Skegness, Lincolnshire, by Friday morning at the latest if they wish accommodation to be reserved for them. Since starting on March 23 last the company has been very busy and has now added to its fleet by the purchase of a "Fox Moth" and another "Puss Moth." The membership of the club has gone up to 125, of which 35 are flying members and 7 "A" licence pilots. Flt. Lt. W. Spencer is now assisting with instruction during the week-end and F/O. N. J. Tindall is operating a "Spartan" for the company from the beach at Mablethorpe. A contract has been secured from the *Leicester Mercury* to deliver evening papers from Leicester. During the autumn two new aerodromes will be opened by the company, one at Bracebridge, near Lincoln, and the other close to Grimsby. That at Bracebridge is an old Service aerodrome where the sheds are still in excellent condition. Among the machines which will be visiting the display on July 31 will be the "Ford" three-engined all-metal monoplane, the "Airspeed Ferry" and the new "Spartan Cruiser."

HANWORTH

Mr. Fred Darling, the well-known racehorse trainer, continues to make use of N.F.S. aircraft extensively, and on both Tuesday and Wednesday Flt. Lt. Max Findlay piloted him in a "Desoutter" to various distant places. On Wednesday Mrs. J. MacAlpine made her first solo flight and her husband, who already holds a pilot's licence, took instruction on the "Autogiro." The Chance Bros. three-lamp floodlight is now installed on the N.E. corner of the aerodrome and was used on Wednesday night for night flying. On Sunday, July 24, the new "Fokker" F. XVIII visited Hanworth and carried a number of passengers.

STAG LANE NEWS

The London Aeroplane Club will be closed on Tuesdays during the month of August to facilitate the arrangements for staff holidays. A visit to Stag Lane is always well worth while, as one is sure to see some interesting machines. On Saturday last there was the new demonstration "Tiger Moth" with the Gipsy, III Ex, engine which Capt. Broad is taking to the Zurich International Flying Meeting. Another machine which excited a lot of favourable comment was the new three-seater cabin "Klemm" with a Gipsy III engine which Mr. John Carberry has just brought over. This machine looks very clean indeed and has the three seats one behind the other slightly staggered so as to provide leg room for the occupants. It is said to have an excellent performance and to be quite fast. Yet another is the special "Puss Moth" upon which Mr. J. Mollison will shortly attempt to fly across the Atlantic and back. The pilot's seat has been shifted back to a position approaching that of the ordinary passengers' seat and the space in front filled with a 75-gall. fuel tank. Behind him there is yet another tank which, together with the tanks in the wings, is said to give him a range of approximately 3,000 miles. We notice that he is relying

on the new Smiths' Turn Indicator and Pitch Indicator for maintaining a direct course when he cannot see the horizon.

LONDON-NEWCASTLE AIR RACE

The following are the entrants for the London-Newcastle air race which is being held on Saturday, August 6:—

LONDON TO NEWCASTLE AIR RACE. SATURDAY, AUGUST 6, 1932.

Machine and Engine.	Pilot.	Entrant.
G-ABVE, Active (Gipsy III) ..	F/O. H. H. Leech ..	A. C. Thornton.
G-ABIX, Active (Hermes IIa) ..	F/O. E. C. Edwards ..	A. C. Thornton.
G-ABLM, Autogiro (Gipsy III) ..	R. A. C. Brie ..	Cierva Autogiro Co.
G-ABLG, Puss Moth (Gipsy III) ..	W. L. Runciman ..	W. L. Runciman.
G-ABJL, Moth (Gipsy I) ..	R. Westenra ..	R. Westenra.
G-ABWA, Puss Moth (Gipsy III) ..	W. Gairdner ..	F. R. Walker.
G-AAZC, Comper Swift (Pobjoy "R") ..	F. R. Walker ..	F. R. Walker.
G-ABOB, Spartan (Gipsy II) ..	F/O. S. A. Thorn ..	Capt. H. H. Balfour
G-ABTR, Spartan (Hermes IIa) ..	Col. L. A. Strange ..	Col. L. A. Strange.
G-ABWW, Comper Swift (Gipsy III) ..	Flt/Lt. E. H. Fielden ..	Flt/Lt. E. H. Fielden.
G-AAHE, Avian (Cirrus III) ..	D. I. Kennard ..	D. I. Kennard.
G-ABFP, Meteor (2, Gipsy III) ..	Flt/Lt. J. G. Armour ..	The Duke of Gloucester.
G-ABWH, Comper Swift (Gipsy III) ..	A. J. Styran ..	I. C. MacGilchrist.
G-ABUA, Comper Swift (Pobjoy "R") ..	Miss F. Crossley ..	Miss F. J. Crossley.
G-ABUR, Percival Gull (Hermes IV) ..	E. W. Percival ..	Lt. Com. E. W. Leake, R.N.
—	B. S. Allen ..	R. Malone.

The meeting at Cramlington, being run in conjunction with this race, is timed to start at 3 p.m., and visiting pilots are therefore asked to arrive before 2.45 p.m. Besides the big race and the local 24-mile handicap race, particulars of which have already been given in *FLIGHT*, there will be a height race, for which cash prizes to the value of £5 are being offered.

THE UNITED FLYING CLUB

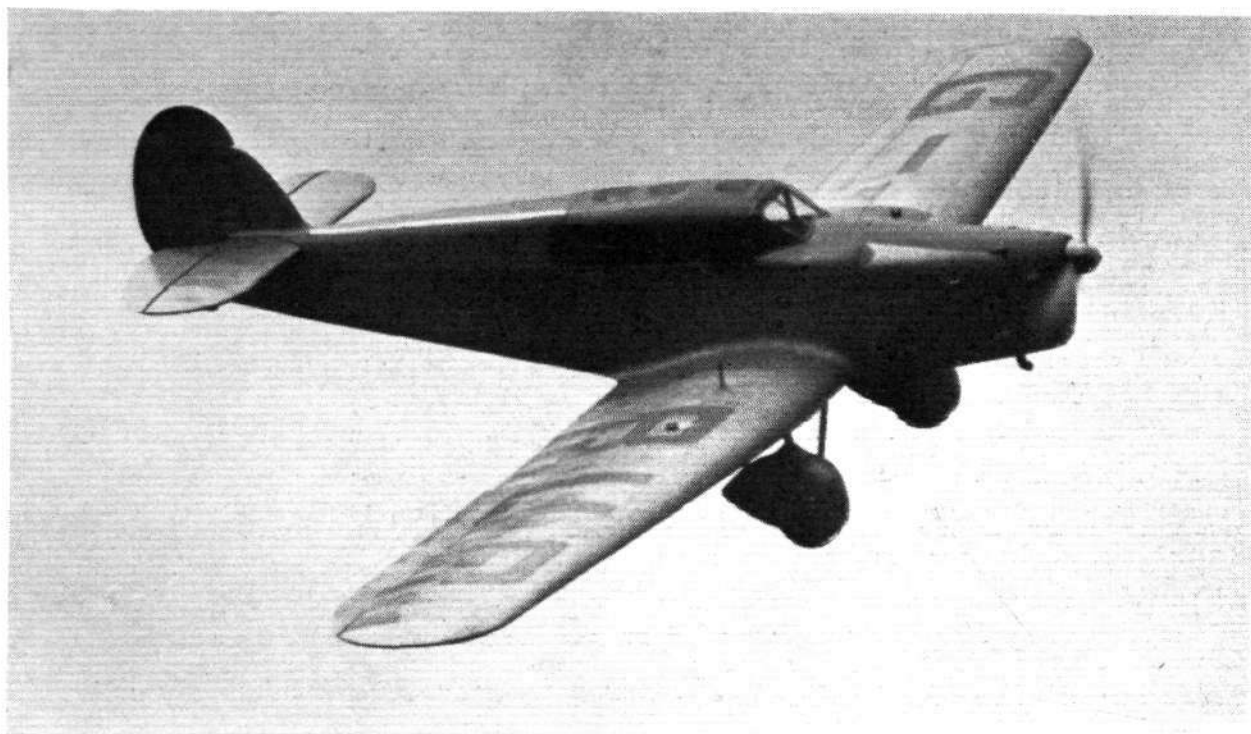
This newly formed club, which operates from Toller-ton aerodrome, by arrangement with National Flying Services, Ltd., has been designed to meet the needs of people who are not in a position to pay the usual flying charges. The entrance fee will only be 10s., while the subscription is as low as £1 6s. per annum (paid quarterly). The charges for instruction will for the present be £2 5s. per hour, but it is hoped to reduce this figure as soon as the membership of the club increases. In order to attain these low rates, flying is restricted to certain specified times, on N.F.S. machines under the pilot in charge of that company. The club has already made a very promising start indeed, great hopes being held for its future success. The President is Sir Albert Ball, the Chairman Mr. H. V. Searson, the Hon. Sec. Mr. S. V. Searson, and all enquiries should be sent to the latter c/o the club at Huntingdon Street, Nottingham.

SURREY AERO CLUB

On Tuesday, July 19, H.R.H. the Prince of Wales used the Gatwick aerodrome of the Surrey Aero Club on his way to Chailey, where he opened a school for cripples. During the week Miss Aitkin completed the tests for her "B" pilot's licence, and Mr. G. H. Dulling the test for his "A" pilot's licence. Quite a large number of visitors arrived during the week-end, showing that the charm of this rural aerodrome, with its 16th century clubhouse, is sufficient to attract people from far and near.



"QUICK OFF THE MARK": Mr. A. B. Gibbons using his Pobjoy engine to pull his "Klemm" off the ground in 49 ft. at Brooklands last Sunday. (FLIGHT Photo.)



The Percival "Gull"

130 h.p. "Hermes IV" Engine

THESE are those who maintain that practically all the progress made during the last ten years or so has been due to improvements in aero engines, and that of real advance in the aerodynamic design of aircraft there has been almost none. It is certainly true that the aero engine has been improved out of all recognition. A gradual decrease in specific weight has been accompanied by a pronounced increase in reliability. This was amply proved during the recent race for the King's Cup, when engine trouble was almost entirely absent in spite of the running of the engines at full throttle for a distance of 1,230 miles. That progress has been made in the aerodynamic design of aircraft becomes evident every so often, when a new type is produced which shows a very much better performance than previously existing machines of comparable type. There was an instance of this with the de Havilland "Fox Moth" flown by Hope in the King's Cup, which he won easily. That machine was very much faster than anyone had expected, and its aerodynamic design must be very clean indeed.

Another type which flew in the King's Cup Race, and one of the "dark horses," being quite a new machine, was the Percival "Gull," fitted with the new "Hermes IV" inverted engine. Although the "Gull" did not succeed in getting a place in the race, it was quite evident, from the fact that it averaged 142.75 m.p.h. around the whole course, that here was a new machine of more than

average efficiency. An examination of the data relating to the machine shows that this impression is indeed well founded.

It is our custom, when describing new aircraft, to endeavour to get an idea of their aerodynamic and structural efficiency by examining certain "figures of merit" which represent, in a general way, these two qualities. For the former the Everling "High-speed Figure" is useful, and a very fair indication of structural efficiency is provided by the ratio of gross to tare weight.

When using British units, but keeping the actual "High-speed Figure" value the same as it would be in the units employed by Dr. Everling in his original article, the formula for the "High-speed Figure" is

$$\frac{\eta}{2k_D} = \frac{V^3}{147,000} \times \frac{S}{\text{H.P.}}$$

where V is the speed in m.p.h., S is the wing area in square feet, H.P. the maximum horse-power of the engine, k_D the "absolute" drag coefficient, and η the propeller efficiency.

In the case of the Percival "Gull," the wing area is 169 sq. ft., the maximum engine power 130 b.h.p., and the maximum speed claimed is 145 m.p.h. These figures give

to the Everling "High-speed Figure" $\frac{\eta}{2k_D}$ a value of 27,



EFFICIENCY: This front view of the Percival "Gull" helps to explain why the machine has such a high performance. (FLIGHT Photo.)



THE UNUSUAL UNDERCARRIAGE : Each wheel is carried on a fork composed of four members, the ends of the axle having their bearings in crossheads. The landing shock is absorbed by the coil springs, and the bouncing is checked by oil dashpots. Our illustration shows the "spat" removed. (FLIGHT Photo.)

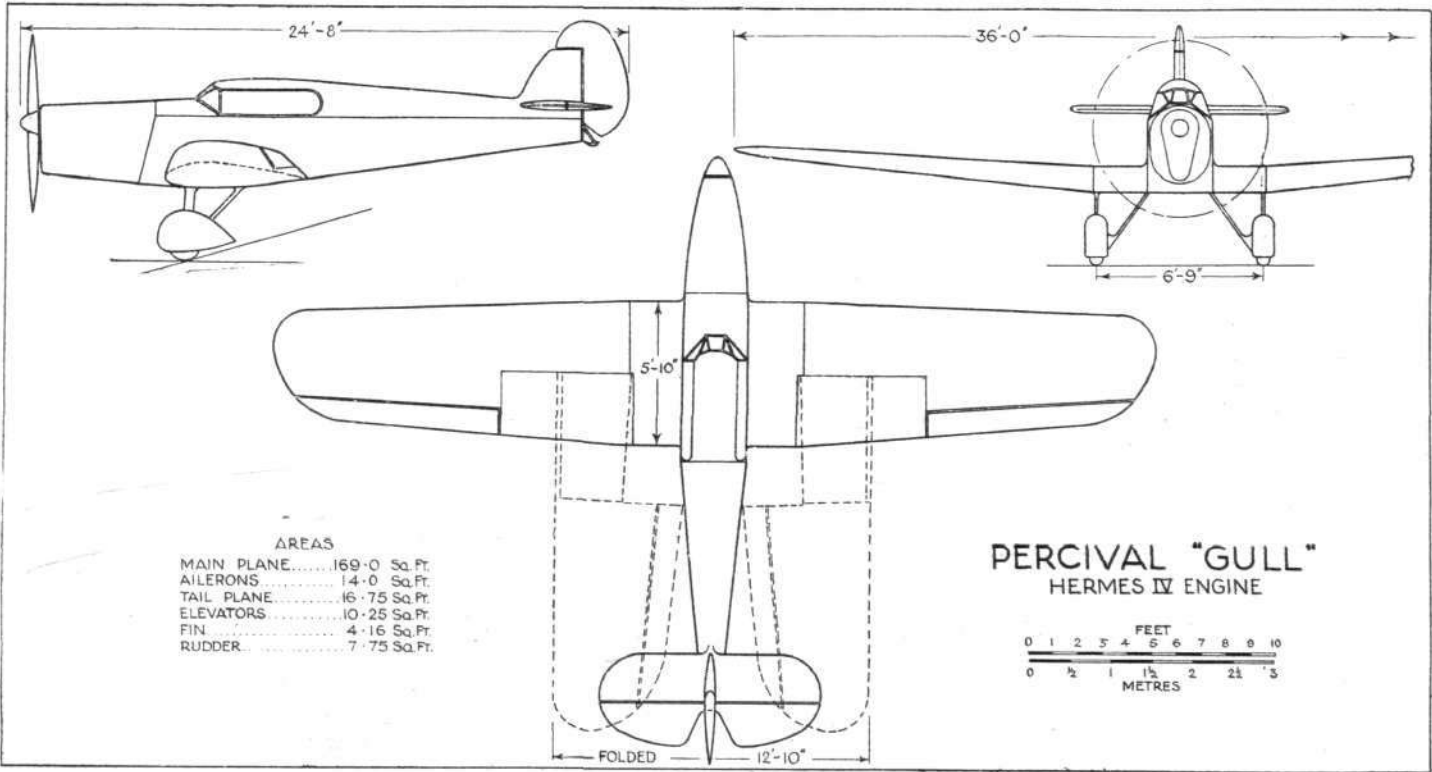
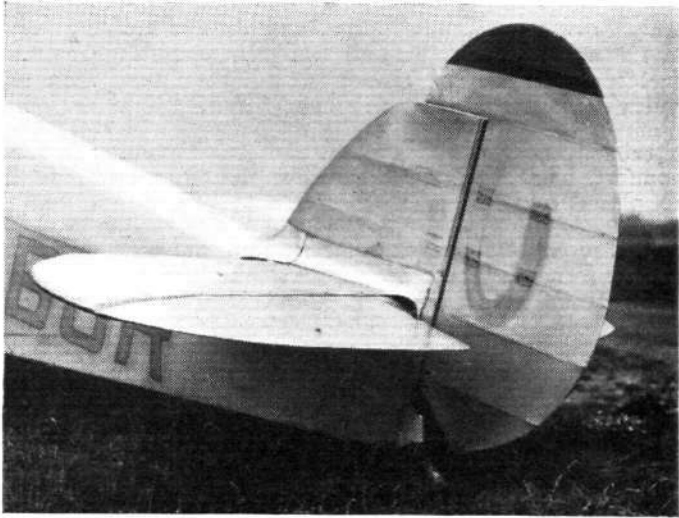
AND THE ORTHODOX TAIL: Below is a view of the tail surfaces, which are of a perfectly normal design and construction. (FLIGHT Photo.)

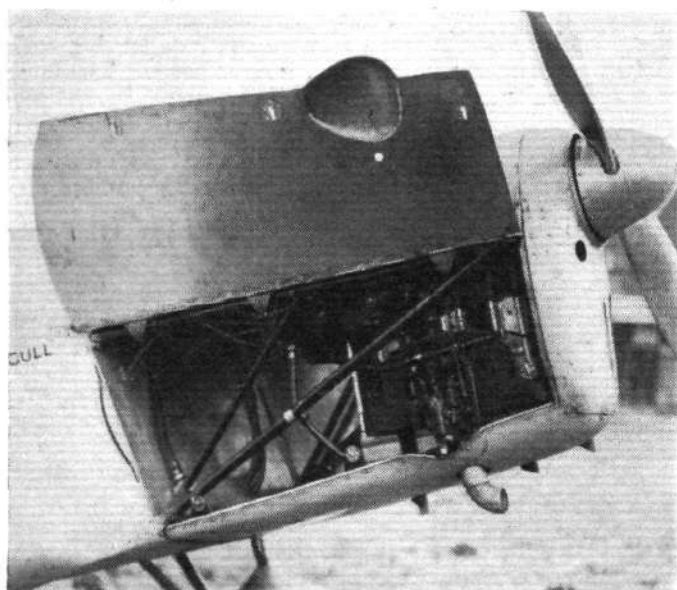
which is the highest we have ever recorded. It is even slightly higher than that for the Schneider machines, and indicates that, assuming the same propeller efficiency, the "Gull" has a lower minimum drag coefficient! When it is remembered that the "Gull" is a three-seater, this is somewhat remarkable.

If the aerodynamic efficiency of the "Gull" is high, the structural efficiency also appears to be well above the average (again probably due to all-wood construction). The gross weight is 2,050 lb., and the tare weight 1,170 lb. This gives a ratio of gross to tare weight of 1.75, which although not the highest we have recorded, is well above the average. (The highest ratio of gross to tare weight of any recent British machine which we have described is that of the de Havilland "Fox Moth," which shows a ratio of 1.9.)

Yet another indication of the efficiency or refinement of an aeroplane is provided by its speed range. The maximum speed of the "Gull" is 145 m.p.h. and the minimum speed approximately 42 m.p.h. This gives a speed range of nearly $3\frac{1}{2}$ to 1, which is a very unusual figure.

Thus, which ever way one looks at it, the Percival "Gull" appears to be an aeroplane with qualities well above the average. This is further borne out by other





ACCESSIBILITY : Above is a view of the "Hermes IV" engine as installed in the "Gull." On the right, a view into the cabin, showing the staggered seats.

features of the machine. For example, the cruising speed is 125 m.p.h. with pilot and two passengers, luggage, and fuel for 700 miles on board. Cruising at more than two miles a minute, with three people "sharing" an engine of a maximum of 130 b.h.p. and a normal power of 120 b.h.p., is economical travelling indeed, and it is travelling in great comfort, as the staggered seats for the two passengers are so placed and spaced that each has sufficient, if not an abundance, of leg room. The pilot's seat, being in front, has very ample space around it, and the view over the inverted engine is excellent.

Structurally the Percival "Gull" is a very straightforward piece of work. The fuselage is a "box" composed of light spruce stringers and struts, the whole covered with a three-ply skin. The cantilever wing incorporates the Hendy Patent wing construction, which consists of two main spars braced in the planes of their upper and lower flanges by a series of lattice ties. This construction gives a wing which is particularly strong in torsion.

The undercarriage is of the divided type, and each wheel is carried on a short axle which rests at each end in a crosshead running in guides. Springing is by two springs on each side of the wheel, an oil ashpot between the two springs on each side serving to damp out bouncing.

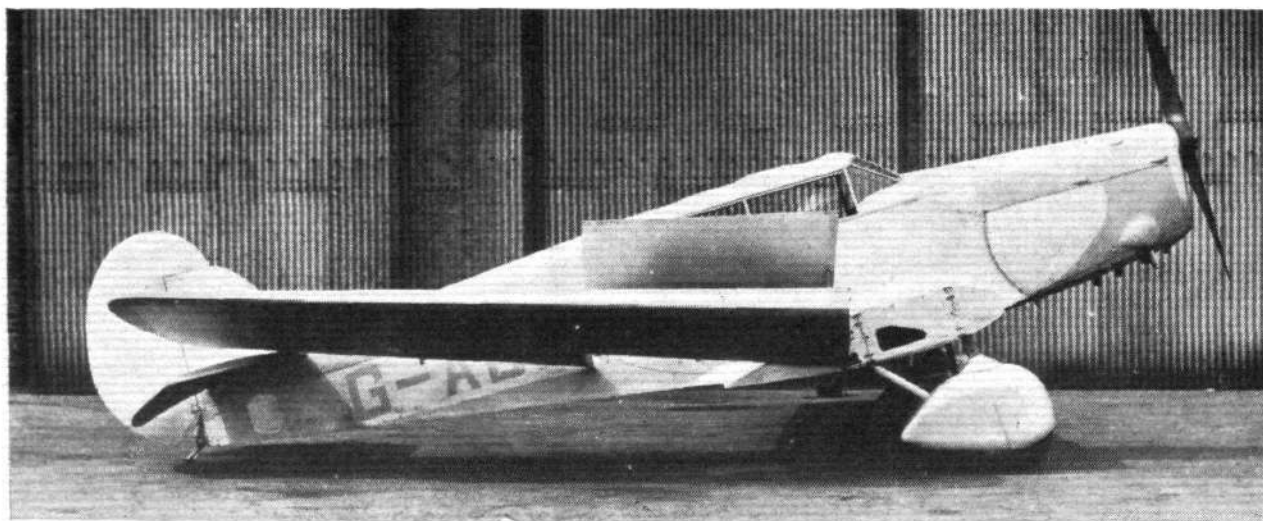
The "Hermes IV" engine is very neatly installed, and the careful cowling to which the inverted engine lends

itself has doubtless contributed materially to the clean lines and high aerodynamic efficiency of the machine. In the King's Cup Race the "Hermes IV" ran without a hitch, and remarkably smoothly. If the engine stood without trouble a distance of 1,230 miles at full throttle, there should be no likelihood of it being other than absolutely reliable when used in the ordinary way at cruising power. (The engine was described and illustrated in our issue of July 8, 1932.)

The petrol tanks are placed in the inner ends of the wings, each having a capacity of 20 gallons. At cruising speed this suffices for a range of about 700 miles. The oil tank is built into the leading edge of the port wing root, and has a capacity of 3 gallons. The tank acts at the same time as an oil cooler.

It is of interest to point out that if the two seats for passengers are removed, the machine can be used as a mail carrier, when it will carry approximately 400 lb. of mails at a cruising speed of 125 m.p.h. over a range of 700 miles. This should be a very useful mail plane on many routes.

Finally, it can be stated that Mr. E. W. Percival has arranged for the "Gull" to be put into production at once, and the first production machine should be ready in about 10 weeks. The price of the "Gull" will be £1,250, completely equipped. Inquiries should be addressed to Mr. Percival at 81, St. George's Square, London, S.W.1.



WITH WINGS FOLDED : The trailing edges of the inner wing portions hinge upwards to permit the wings to be folded back. No jury struts are required, the hinges being strong enough to take the weight of the wings. The petrol and oil tanks are housed in the wing and roots respectively. (FLIGHT Photo.)

The AIRCRAFT ENGINEER

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THE ESTIMATION OF PROFILE DRAG.

By W. R. ANDREWS, A.F.R.Ae.S.,

(Concluded from page 44)

The writer was very chary about attempting any generalisation of K_{Lmax} .

The variations possible may not all be covered by the tests available.

After much consideration, the following notes have been compiled to provide, tentatively, a basis upon which the estimates of profile drag may be completed.

The observed values of K_{Lmax} for the systematic series tested are given in Figs. 9 and 10.

From an analysis of these and other results, it would appear that the maximum lift coefficient could be expressed in terms of the following parameters:—

- (1) The thickness to chord ratio.
- (2) The moment of no-lift.
- (3) The point on the chord at which the maximum camber occurs.

There is no evidence to show how the aspect ratio affects the maximum lift.

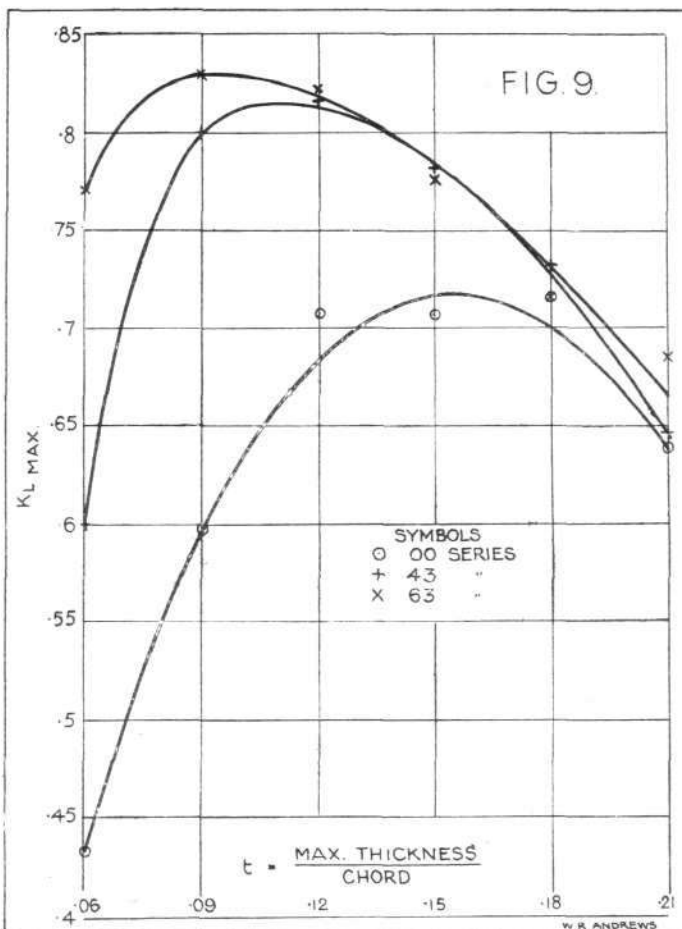
It might be argued that the maximum lift occurs at approximately the same angle of incidence for a given section regardless of aspect ratio.

There seems to be justification for such an argument. Pressure plotting tests show that for a monoplane, the centre portion of the wing stalls first, and the wing tips last.

As is well known, the angle of incidence at the centre of a wing is greater than at points nearer the tips.

Therefore, it may be argued that as the sections of the wing reach a certain incidence stalling takes place.

When applied to a biplane, this hypothesis accounts, in a measure, for the drop in maximum lift from monoplane to biplane, since the effective aspect ratio of the biplane is usually less than that of a monoplane.



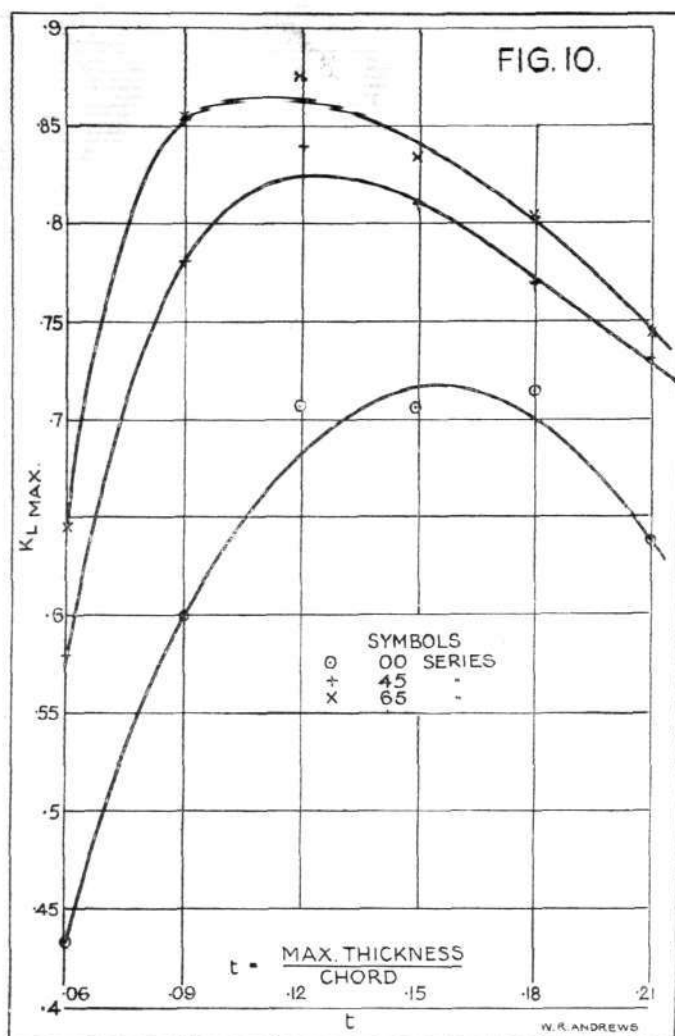
Maximum lift coefficients.

The effective aspect ratio of a biplane may be as low as 3.5, whereas the tested model wings are usually either 5 or 6.

Reducing the aspect ratio from 6 to 3.5 would mean an increase in the stalling angle of about 3 deg. for a normal wing with a maximum lift coefficient of 0.7 at aspect ratio 6.0.

The corresponding reduction of lift coefficient, if stalling takes place at the same angle of incidence, would be 0.094, which is approximately in keeping with full-scale results.

With a biplane—and a monoplane for that matter—

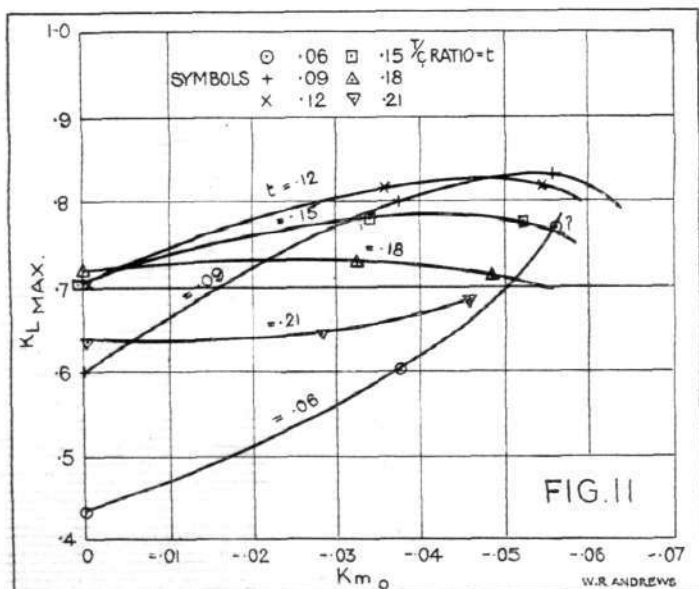


Maximum lift coefficients.

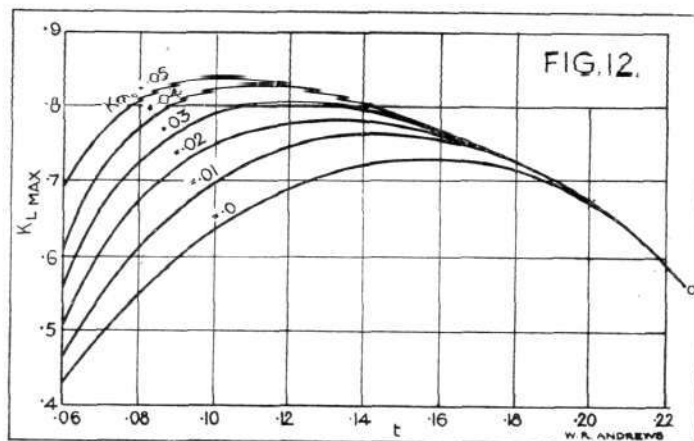
there are other factors which govern the lift coefficient developed on the wings. The position and size of the body, and the gap between aileron and wing, etc., all have their effect on maximum lift.

Returning to the question of $K_{L \max}$ for the monoplane wing, Fig. 11 gives the values of lift for the sections having the maximum camber at 0.3 of the chord plotted against K_{m_0} .

Generally speaking, sections having the maximum camber at 0.5 of the chord give a slightly higher maximum lift than when the maximum camber is at 0.3 c.



Maximum lift coefficients for sections having their maximum camber at 0.3 of the chord.



Maximum lift coefficients for sections having their maximum camber at 0.3 of the chord.

There are no tests to show how $K_{L \max}$ varies with the point along the chord at which maximum camber occurs.

The general shape of the $K_{L \max}$ curves is approximately the same, whether the maximum camber is at 0.3 or at 0.5 of the chord.

As pointed out previously the sections having maximum camber at 0.3 c. represent most nearly the majority of aerofoils in present use.

The tests carried out on aerofoils having maximum camber at 0.5 c. are, therefore, not used for want of data connecting $K_{L \max}$ with the point of maximum camber.

Fig. 12 gives the results of cross plotting the curves of Fig. 11.

These curves are instructive as they show that the thicker the section the less important the camber of the section becomes, so far as maximum lift is concerned.

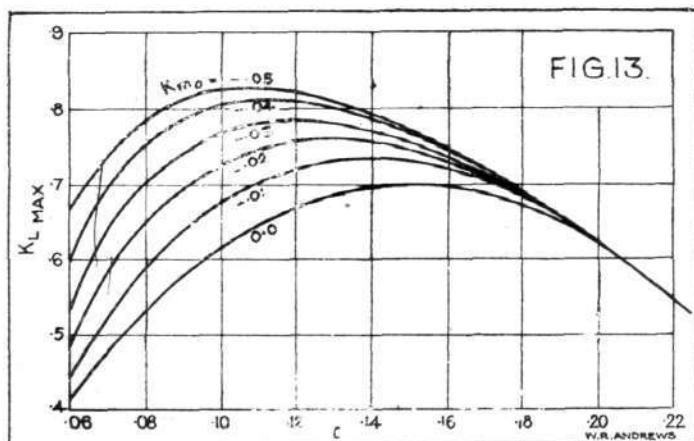
At 20 per cent. thickness the only effect of camber is to increase the value of the profile drag. On such a section the camber does not appear to move $K_{L \text{opt}}$ far from no-lift, as shown by Figs. 4 and 5.

It is concluded that as the thickness ratio increases above a certain amount, the camber must be decreased to obtain the most efficient section, the efficiency being measured as the ratio:—

$$\frac{K_{L \max}}{K_{D_p \text{ cruising}}}$$

The values of maximum lift obtained from Fig. 12 are somewhat higher than those obtained on monoplanes using conventional sections.

The test on sections—Gott 398, B.106 and N.60 (Reference 7)—and certain full-scale results at the writer's disposal have suggested Fig. 13 as being fairly representative of the lift coefficient obtained on a full-size monoplane.



Maximum lift coefficients. Generalised curves for monoplanes.

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It will, of course, be necessary to modify these $K_{L_{max}}$ curves as fresh data becomes available, but in the meantime they provide a fairly reliable guide upon which estimates can be based.

For a biplane (in the absence of tests showing the effect of aspect ratio) the maximum lift may be taken as about 90 per cent. of that for a monoplane, Fig. 13.

Using the foregoing data, it is now possible to estimate the complete profile drag curve for any normal wing.

This has been done for the sections given in Ref 7.

The agreement is in most cases too close to show on a graph, so the results have been tabulated as follow:—

TABLE 3

Section Camber Ratio, K_{m_0} Thickness Ratio, t $K_{L_{max}}$	Gott 398			Gott 398.R		
	0.0477			0.0325 Reflexed		
	-0.041			-0.0035		
	0.1385			0.1385		
	K_L	K_{D_p}	K_{D_p}	K_L	K_{D_p}	K_{D_p}
	Obs.	Calc.	Obs.	Obs.	Calc.	Obs.
	0.2245	0.00551	0.00555	0.084	0.00513	0.00495
	0.3725	0.00591	0.0063	0.236	0.00533	0.00545
	0.516	0.00686	0.00795	0.386	0.00643	0.0065
	0.6515	0.00996	0.01135	0.5295	0.00838	0.00875
	0.757	0.01516	0.01965	0.655	0.01518	0.01425
	0.786	0.01871	0.0319	0.6845	0.02013	0.02775

TABLE 4

Section Camber Ratio K_{m_0} Thickness Ratio $K_{L_{max}}$	B 106			B 106.R		
	0.0327			0.0241 Reflexed		
	-0.0260			-0.0005		
	0.1306			0.1306		
	K_L	K_{D_p}	K_{D_p}	K_L	K_{D_p}	K_{D_p}
	Obs.	Calc.	Obs.	Obs.	Calc.	Obs.
	0.110	0.00496	0.00485	0.041	0.0048	0.00465
	0.185	0.00501	0.00490	0.193	0.0050	0.0050
	0.258	0.00516	0.00530	0.341	0.0058	0.00595
	0.406	0.00596	0.00635	0.490	0.0089	0.0079
	0.547	0.00871	0.0085	0.623	0.0125	0.0121
	0.676	0.01121	0.0128	0.678	0.0182	0.01675
	0.7675	0.01796	0.02665	0.691	0.0192	0.0352

TABLE 5

Section Camber Ratio K_{m_0} Thickness Ratio $K_{L_{max}}$	N. 60			N. 60.R		
	0.0385			0.0295 Reflexed		
	-0.0400			-0.0005		
	0.1245			0.1245		
	K_L	K_{D_p}	K_{D_p}	K_L	K_{D_p}	K_{D_p}
	Obs.	Calc.	Obs.	Obs.	Calc.	Obs.
	0.1335	0.0050	0.00505	0.056	0.0048	0.00465
	0.212	0.0051	0.00495	0.132	0.0048	0.00460
	0.289	0.0052	0.00525	0.2095	0.00492	0.00495
	0.365	0.0055	0.0056	0.364	0.0058	0.0058
	0.513	0.0069	0.0069	0.514	0.00805	0.00715
	0.650	0.0096	0.0100	0.6525	0.0134	0.0122
	0.771	0.0157	0.0156	0.7035	0.0198	0.0193
	0.808	0.0200	0.0246	—	—	—

The observed values have not been faired in any way but are taken direct from Reference 7, after correction to British notation.

The agreement between the experimental and calculated values of K_{D_p} given above might be considered satisfactory, except perhaps for Gott 398 at the higher values of K_L and at the stall for some of the other sections.

The disagreement in the case of Gott 398 would cause a slight over-estimate in the rate of climb, but at top speed the estimated drag would be correct.

The reflexed sections Gott 398.R, etc., have been designed to give no-moment at no-lift in each case.

From these results it is apparent that the drag of such reflexed sections is the same as that for non-reflexed sections of the same maximum camber.

The maximum lift coefficient for the reflexed section is less than that for the non-reflexed of same camber. This is allowed for in Figs. 11, 12 and 13 by plotting $K_{L_{max}}$ against K_{m_0} .

From this it is suggested that a reflexed section has the same maximum lift as a symmetrical section of the same thickness to chord ratio, the profile drag and $K_{L_{opt}}$ corresponding to the maximum camber.

The tests on the symmetrical sections show that in many cases the flow is very unstable at maximum lift.

The stall takes place very suddenly and a reduction of angle, once the stall has taken place, results in a much lower lift coefficient at the original stalling angle.

This effect seems to be worst round about 12 per cent. thickness ratio

There is no evidence to show whether or not this effect is present with small cambers, or at what minimum camber it vanishes. There is no evidence of it with the reflexed sections nor with the sections of cambers of 0.04 c., but such cambers are somewhat higher than the average used in biplane work.

Further tests are, therefore, necessary before it can be stated what is the lowest camber for a non-reflexed section which can be used with any thickness ratio to avoid a sudden stall.

The question of no-lift characteristics is under investigation by the writer, but certain difficulties have presented themselves.

It may be necessary to await further tests before any generalised curves or empirical correction to the method of R. & M. 910 (Reference 10) can be developed.

It is suggested, therefore, to leave this section of the problem of the prediction of aerofoil characteristics to be dealt with in a later article.

10 R. & M. 910. A Theory of Thin Aerofoils. H. Glauert, B.A.

STRIP MANIPULATION.

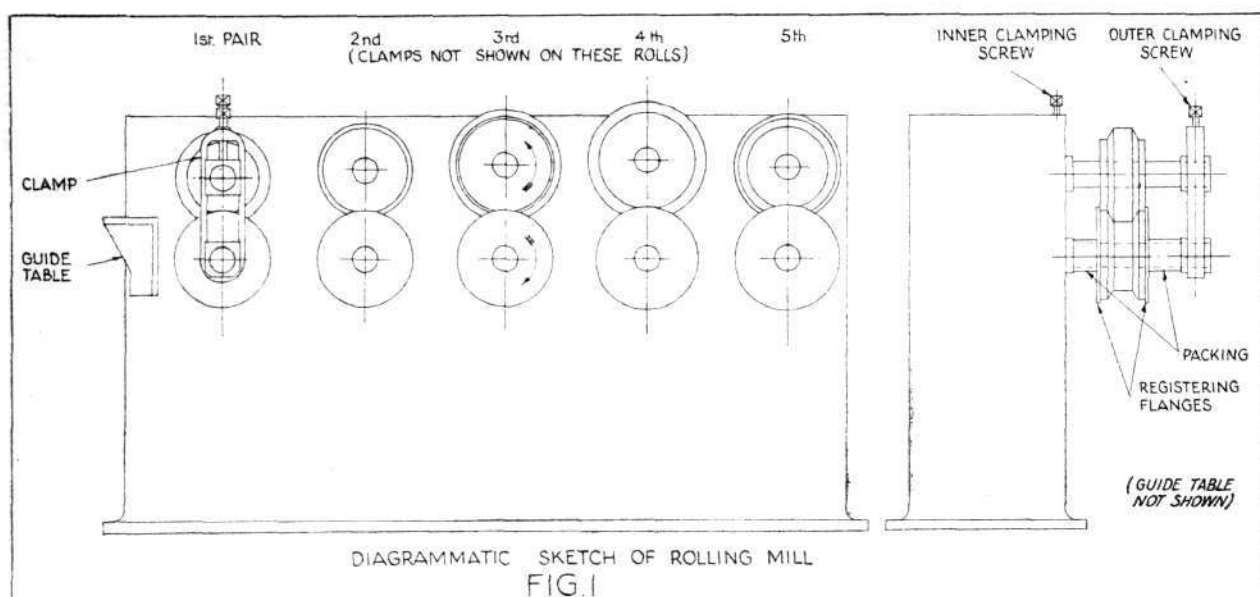
By W. S. HOLLYHOCK.

THE most common methods of forming lengths of corrugated or augulated sections for use in aircraft structural members are the manipulation of comparatively thin strip by "rolling" or "drawing," and the process known as extrusion.

The latter is not greatly used, partly because the resulting sections are not economical from the point of view of weight for most aircraft work, and partly because aircraft manufacturers have not usually the facilities or plant for carrying out such work themselves.

The process of rolling consists of forming the required section by bending flat strip between pairs of rolls. The strip is carried along by the rolls, which are themselves

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driven by some outside source of power. It is sometimes convenient to finish the section with a die through which the metal is pushed by the rolls.

Drawing is the process of drawing the metal through (a) rolls which are rotated by the metal itself—not by any outside source of power—or (b) dies which force the strip to pass through orifices shaped to give the required section.

Having regard to the popularity—one might almost say universality—of metal construction nowadays, a brief description of the above processes of strip manipulation may not be out of place.

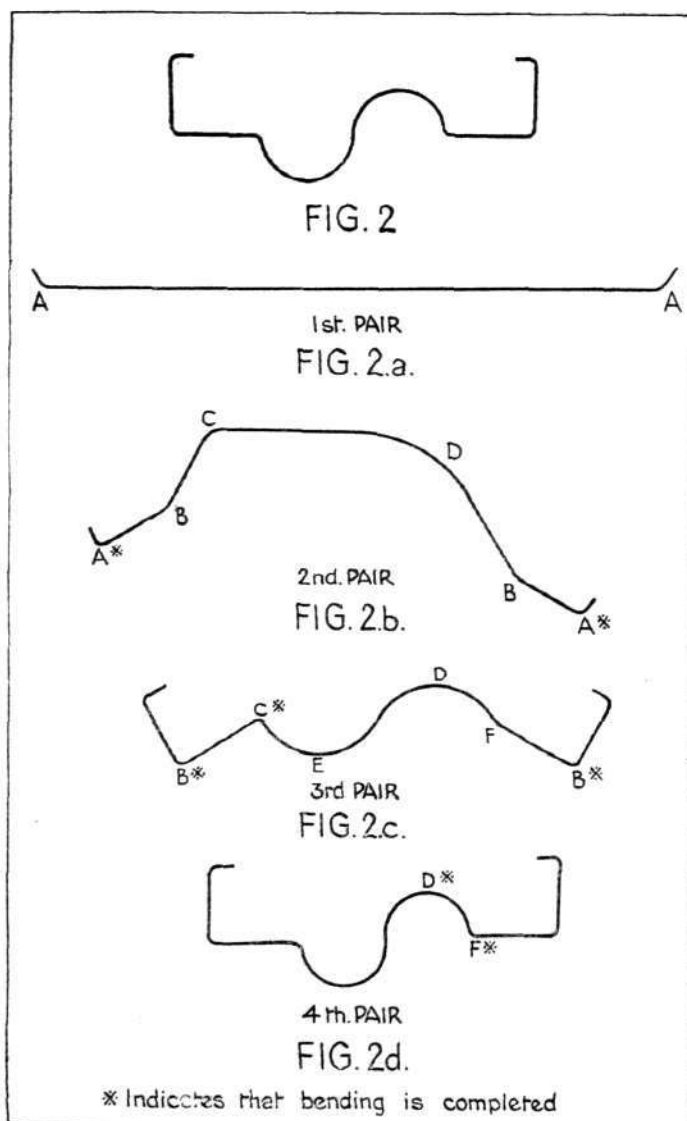
Rolling.

This is carried out on a mill such as is shown diagrammatically in Fig. 1. The metal strip, if not of the exact width required, will have to be slit. This should be done, if possible, in conjunction with the actual rolling in order to save the time and cost of separate handling. The first few feet will need to be slit independently, but once the metal is started in the mill the rolls will pull it through the slit. In most cases a guide table will be needed to guide the strip into the first pair of rolls. After passing through the first pair, however, no further guidance, apart from that given by the rolls themselves, should be necessary.

The number of pairs of rolls required to completely form a section will depend, of course, on circumstances—the number of bends in the finished section being the chief factor to consider. The rolls work in pairs on spindles suitably geared to give the material being rolled a forward speed of approximately 10 ft. per minute. The lower roll of a pair should be keyed to its shaft and the upper one free to rotate and slide sideways independently. There are two reasons for this; one is that the lower spindles are generally driven direct, while the upper ones are geared to them. Consequently, in cases where the rolls have to be of large diameter, the sprockets are completely out of mesh and the upper rolls cannot drive. Even when not entirely out of gear, the sprockets do not work at correct centres and therefore do not give a smooth drive. This results in a form of "hunting" between different pairs of rolls, with consequent dragging of the metal. The other reason is that if the lower rolls are keyed, these can be set up and adjusted without the upper ones being in place. It is only necessary then to slide the upper ones into position. This may necessitate dismantling some of the lower rolls again, but they should not need any further adjustment.

With regard to the design of the rolls, there are many factors which must be taken into account if good results

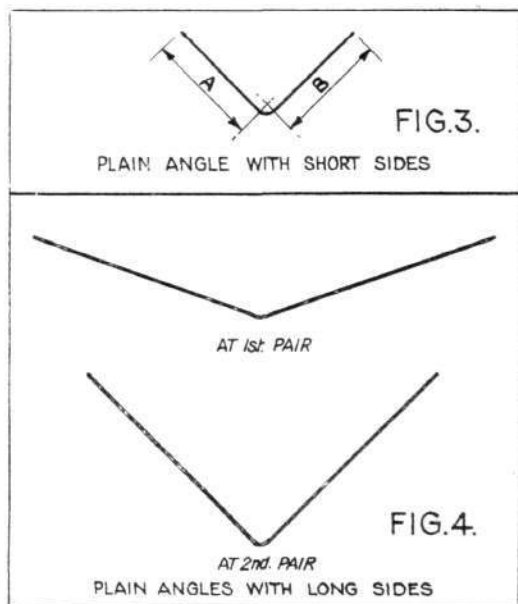
are to be obtained. Of these, two are of paramount importance. The first being that "that portion of the strip which does not move vertically between two adjacent pairs of rolls, must not move laterally in its passage between them." It should be noted that the part concerned may, or may not, be the middle of the strip. The foregoing may seem like a glimpse of the obvious, but is by no means so apparent in practice if attention is not drawn to it. The other really fundamental law is that the strip as a whole must not appear to move vertically in waves when viewed from the side of the mill. This is an equally important, though not



so obvious, law, and its explanation can be more satisfactorily dealt with if some other points of a more general nature are considered first.

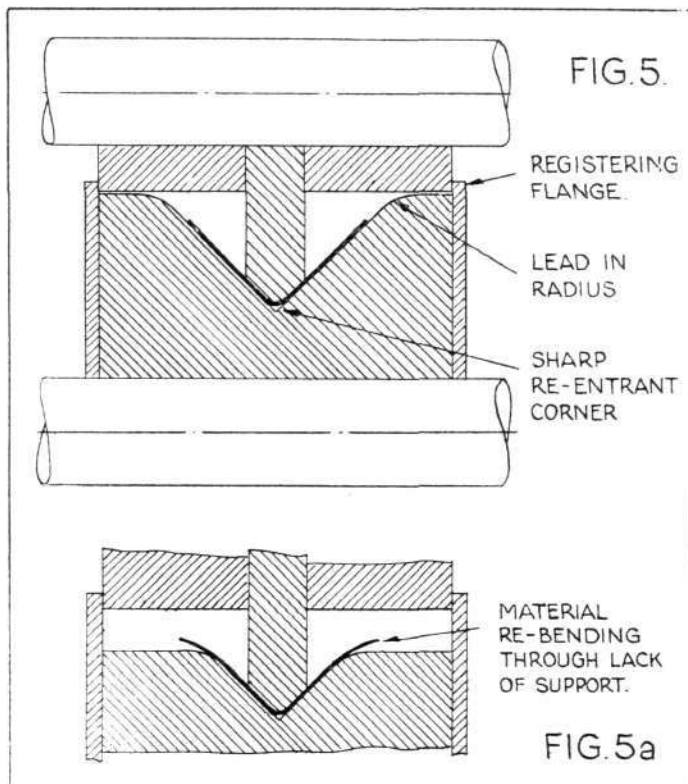
Consider the section shown in Fig. 2. Such a shape, though somewhat fantastic, is interesting by reason of its asymmetry and reverse bends. It also exemplifies most of the types of bend to be met with in this class of work. In all such sections as this, the small lips at the extreme ends of the shape should be formed first. The extreme flanges should be formed first in most sections, even when they are not small as these are. The reasons for this are (1) as the major portion of the strip remains flat, there is less tendency for it to wander laterally on entering the first pair of rolls; (2) it enters all the rolls except the first pair as a moderately stable section—the risks of its wandering, buckling or winding being thereby materially reduced (the causes of buckling and winding will be explained later); (3) the extremities, being dealt with immediately on entering, are not so likely to damage any but the first pair of rolls, as the later ones can be designed to either miss the edges altogether or at least pass them through without doing any work on them. This is important when dealing with high-tensile steel, as the edges are often razor keen and can do considerable damage since a few inches of roll surface are often called upon to work thousands of feet of strip; and (4) the corners formed by these outer lips or flanges are very useful for guiding the strip through the later rolls as they act as definite butting faces but do not damage the rolls.

The actual design of the rolls must, of course, be governed to a great extent by the type of section to be formed. 90° bends, for example, will not invariably answer to the same treatment.



Leaving, for the moment, the section already mentioned, consider the plain angle shown in Fig. 3. If the lengths A and B are not great, this section can be completely formed with one pair of rolls if worked in the attitude shown in Fig. 3, i.e., with both sides rising at the same angle to the horizontal. If the sides are long, however, it will be necessary to use two pairs as shown in Fig. 4. In either case, the rolls must back up the material to its extremities, otherwise it will pull down as shown in Fig. 5 (a).

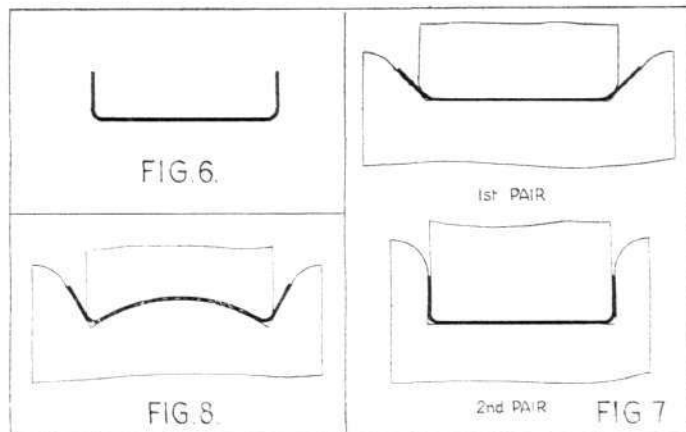
If the required section is a channel such as that shown in Fig. 6, it will generally be necessary to use at least two pairs of rolls, forming the corners by degrees as shown in Fig. 7. If the back of the section is long, it is sometimes possible to form the corners in one pair of rolls by bending the back to a large radius as shown in Fig. 8. This radius, by the way, must not be less than a certain definite figure (as will be explained later),



or the material will take a permanent set and require re-bending to obtain the correct shape. Undue bending of the metal, however, is to be deprecated and, consequently, this method should be avoided where possible. Returning now to the section shown in Fig. 2 and assuming that the material to be worked is steel, the first pair of rolls should produce the section shown in Fig. 2 (a). In the second pair, the corners "A" should be finished and the corners "B" and "C" and the curve "D" partially formed, the general idea being to work gradually in towards the middle of the strip.

When deciding on the amount of work to be done by any particular pair of rolls, it should be borne in mind that the work should be kept within as small a space, vertically, as possible; partly to avoid stretching the extremities of the metal and partly to minimise rubbing on the rolls. At the same time, the regions actually being worked should be kept as nearly as possible on the same horizontal level. The reason for this is as follows:—

Suppose the portion of metal at "B" (Fig. 2 (c)) is moving forward at a speed V , then assuming a condition of no slip, the angular velocity of, say, the lower roll will be V/R_1 , where R_1 is the distance of "B" from the spindle centre. Similarly, if there is to be no slip at "E," the angular velocity there must be V/R_2 , where R_2 is the distance of "E" from the spindle centre and V the forward velocity as before. Therefore, since the angular velocity of all parts of any one roll must be the same, R_1 must equal R_2 . This, of course, is not usually



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possible, so that some slip is inevitable. But, by making R_1 and R_2 as nearly equal as possible, the amount of slip will be reduced to a minimum. This consideration is less important where the radius of bend is large—as at the curve “D”—because the damage done and power lost in friction when slip occurs is proportional to the work done in bending the metal. On the other hand, the transverse length of surface being worked is generally greater where the radius is large, thus increasing the power loss due to slip. Consequently, it is desirable to have all bends, sharp or otherwise, as nearly in line as possible.

Incidentally, there will be increased slip if the upper rolls are not free to rotate independently, due to the fact that the angular velocity of both rolls will be the same if they are geared together, whereas the diameters cannot possibly be the same. Such a condition results in the slip between the rolls themselves being of a fixed value. If, on the other hand, they are not geared together the slip automatically reduces to a minimum.

One other point that needs emphasis is that the line of work should be as nearly as possible midway between the two spindles in order to keep the smallest diameter as large as possible. The reason being that any given linear difference between R_1 and R_2 , say, will cause a greater difference in peripheral speed if R_1 and R_2 are themselves small, since, obviously, the difference becomes a greater proportion of the whole.

Referring to Fig. 2 (b), it will be seen that, although no very severe work is done in the second pair of rolls, three more sharp corners and one curve are partially formed. Fig. 2 (c) shows the section after passing through the third pair. It will be seen that the corners “B” and “C” are now finished, while “F” and the two curves “D” and “E” are well on the way. “D” could easily have been finished in this or even the second pair, but a little consideration will show that to have done so would have made it impossible to form the corners “B” and “F” satisfactorily and would also have given the section an undesirably great depth. In the fourth pair “D,” “E” and “F” are finished and the section is completed. In passing through this last pair it is distorted to overcome the effects of spring-back, but takes its proper shape on leaving the rolls. The subject of spring-back will be dealt with in detail later.

Considering now the question of waviness in side view as the metal passes through the mill. Since the section changes at each pair, certain parts of the metal must inevitably wave, but the amplitude of the waves can be restricted considerably by careful design. The diameters of the lower rolls are, of course, the governing factors because the lower spindles are all on the same horizontal level. When determining these diameters, the middle portion of the strip should be considered chiefly, since the extremities being in the nature of free edges are not so likely to stretch or take permanent sets through waving.

With regard to the number of pairs of rolls that are necessary to produce a section satisfactorily, experience is the only true guide. The aim, of course, is to use as few as possible in order to minimise initial cost, maintenance cost—all rolls need trueing up occasionally and some very frequently, cost of setting up for each batch of material and power consumption—since all pairs in excess of the optimum number will only increase the frictional losses, thereby using more power (or slowing down the work if the speed is not controlled).

On the other hand, if too few rolls are used the amount of work required of each pair becomes excessive; with the result that either the mill is unable to cope with the loads imposed or the strip stretches—or both. Such stretching, if it occurs at the edges, will result in a straight centre portion (perhaps) and wavy edges. If the middle of the strip is stretched, then hills and hollows will occur in the main part of the section.

In either case the section will probably be bowed lengthwise. The most serious disadvantage, however, to having too few rolls is the likelihood of cracks developing in the corners of the section owing to the working being too severe. These are often practically invisible, but are, nevertheless, such a potent source of danger, that the presence of one hair crack half an inch long will necessitate the scrapping of possibly 30 ft. of material.

Inspection for cracks is a lengthy and, therefore, costly process, and in certain cases where the section is a closed one with re-entrant bends, is not possible at all without destroying the work; so that it pays to have sufficient rolls to put the work beyond suspicion in the first place.

One rather serious problem which arises in the actual process of rolling, is the elimination of bowing (longitudinal curvature of a length of rolled material). This defect is not usually attributable to errors in design of the rolls. It may be due to errors in setting up, but the cause is more likely to be found in the raw material itself. Taking the section in Fig. 2 as an example, if the strip is curved when laid out flat before rolling, the finished section will almost certainly be bowed sideways. This can sometimes be overcome by deliberate uneven tightening of the rolls, but such action is most undesirable, as it may lead to all sorts of trouble—from cracked rolls to cracked work. Generally speaking, if the bowing is too serious to ignore and can be directly traced to the raw material, the stuff should be returned to the makers. When the strip is laid out flat, waviness is often apparent. If at all serious, this also will lead to bowing. If the edges are wavy, sections similar to that of Fig. 2 will tend to bow downwards on leaving the rolls. Conversely, bagginess of the middle of the strip will cause upward bowing. Undue loss of thickness towards the edges of the strip will also tend to have the same effect.

On the other hand, however, if the material is not faulty, either the setting up or the rolls will be to blame. In which case the following remarks should serve as a guide to correction:—

Lateral bowing.

Rolls may be unequally tightened—e.g., outer clamping screws too tight—this will cause the section to bow towards the mill on leaving the last pair.

Rolls not in proper alignment sideways.

Upward bowing.

Centre portions of one or more rolls may be oversized.

Rolls working on middle portions of strip may be too tightly clamped—thereby squeezing the metal.

Downward bowing.

The reverse of the causes of upward bowing.

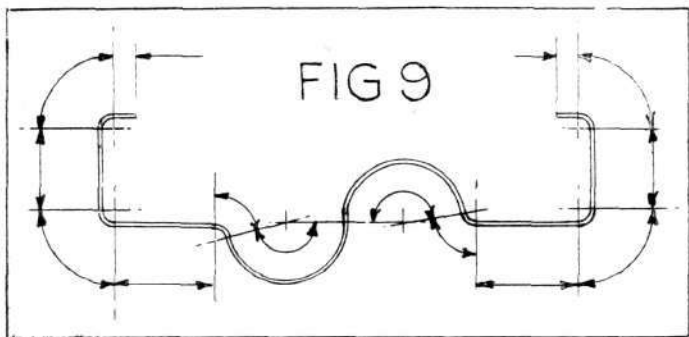
It should be noted that the above remarks apply to sections similar in shape to that illustrated and would not necessarily be true for sections of a radically different character.

General Design Considerations.

The first requirement is an accurate enlarged layout of the finished section, preferably ten times full size. This scale gives ample magnification and minimises the possibility of errors occurring, since it is only necessary to move the decimal point when translating dimensions from the actual section to the layout. The section so drawn should be divided up into its elemental straights and curves as shown in Fig. 9, and the lengths of all the pieces calculated and checked graphically. This accuracy is important because a small error at the commencement may lead to unsatisfactory results without giving any clue as to their cause. Much time may thus be lost in costly experimenting before it is decided to work through the design again from the beginning.

Next, the proposed sections at the various rolls should be drawn out—preferably to the same enlarged scale.

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The rolls can then be built up round them, care being taken to back up the metal, as shown in Fig. 5, to prevent reverse bending.

Some register must be provided to key together the upper and lower rolls of each pair. The working surfaces themselves will sometimes automatically do this, but generally it is necessary to have flanges on one or other of the rolls. These may be integral with the rolls or may consist of discs assembled with the rolls on the spindles—see Fig. 5.

In order to minimise friction, wear of rolls and unnecessary working of the strip, the rolls should be designed to touch the metal only where it is absolutely essential. For this reason and to save machining cost, it is usually advisable to allow only nominal radii in re-entrant corners on the rolls—the work being done on the male portion at these points; nothing is gained by having the metal restrained on both its sides (see Fig. 5).

Another important point to be considered is the provision of a good lead-in, both to ease the metal round gradually and to prevent the rolls scoring or chafing it. To this end generous radii and open angles on the parts that touch the material first should be provided, as shown in Fig. 5. For the same reasons, vertical walls should not be produced completely in one pair of rolls unless they are very small.

To economise in initial work and subsequently in setting up time, it is often desirable to cater for more than one thickness of strip when designing the rolls. In such cases the thickest material to be considered should be taken as the basis of calculations and rolls should never be called upon to deal with any strip more than 20 per cent. thinner if accurate results are required.

(To be continued.)

TORSION CALCULATIONS FOR A REAR FUSELAGE WITH TWO OR MORE "UNKNOWNNS."

By H. DAVIES, B.A., A.F.R.Ae.S.

I SHOULD like in the following remarks to refer again briefly to the above problem, which was dealt with in last month's issue of THE AIRCRAFT ENGINEER.

Attention is directed to the attached diagrams 3 and 4. These figures show the load system applied to

the aftermost bulkhead of the rear fuselage, in terms of two unknown reactions at the stern end. Fig. 3 applies to the conventional way of treating the rear fuselage, and shows the load system in terms of two unknown reactions, x and y at the stern end of the fuselage. Fig. 4 applies to the proposed new method of treatment. Here x and y are grouped together and replaced by a single variable u , where $u = x + y$.

Fig. 4 shows the load system applied to bulkhead CcdD in terms of the two new unknowns, x and u . It will be observed at once that u has the dominating influence on the rear fuselage, while the effect of x is to apply a small correction. This condition should be contrasted with the load system of Fig. 3, where x and y are seen to have an approximately equal influence on the rear fuselage structure.

In the previous article, appearing in the June issue of THE AIRCRAFT ENGINEER, complete strain energy calculations were given for the rear fuselage in terms of the new variables x and u . The final resultant equations—which were readily soluble—were as follows:

$$\begin{aligned} (1) \quad & 4,323x + 7,360u - 40.83 \times 10^6 = 0 \\ & \text{or } 0.587x + u - 5,550 = 0 \\ (2) \quad & 7,360x + 301,430u - 684.1 \times 10^6 = 0 \\ & \text{or } 0.024x + u - 2,270 = 0 \end{aligned}$$

$$\begin{aligned} \text{These give: } x &= 5,830 \text{ lbs.} \\ u &= -2,130 \text{ lbs. } (= x + y) \\ y &= -3,700 \text{ lbs.} \end{aligned}$$

For purposes of comparison, strain energy calculations on the same rear frame have been carried out in terms of x and y (Table 5 of the previous article gave a specimen of these calculations for the top longerons; the remainder of the calculations were not included). The final resultant equations in terms of x and y are as follows:

$$\begin{aligned} (3) \quad & 320,890x + 308,900y - 725.5 \times 10^6 = 0 \\ & \text{or } 1.040x + y - 2,348 = 0 \\ (4) \quad & 308,900x + 301,430y - 684.1 \times 10^6 = 0 \\ & \text{or } 1.025x + y - 2,269 = 0 \end{aligned}$$

These equations give a crude solution which is in reasonable agreement with that obtained above; but the equations are far too similar to make any accurate solution possible.

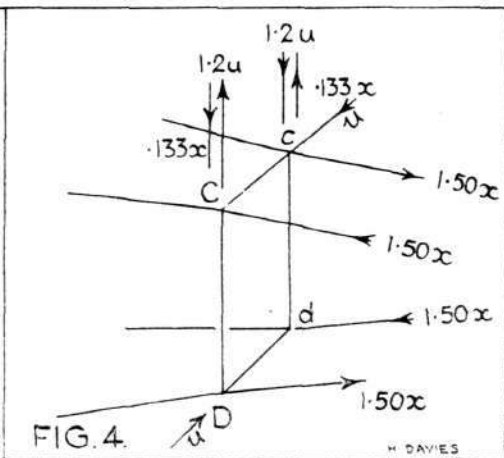
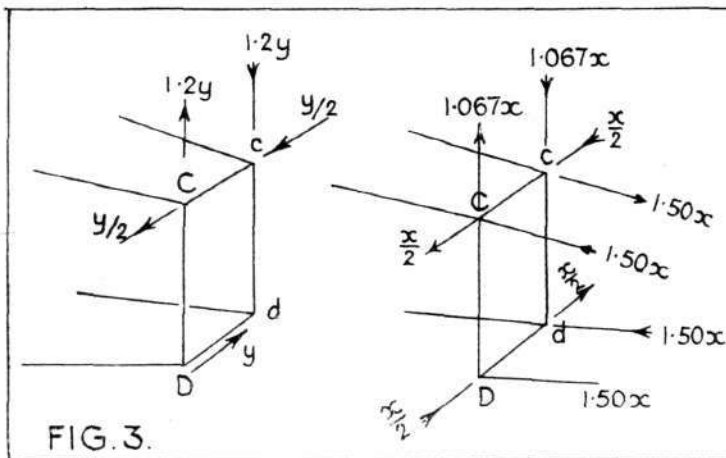
ERRATA.

ATTENTION is drawn to two mistakes which occurred in Mr. Davies' article last month:—

In Fig. 4, on p. 46, "1.50u" should have read "1.50x."

On p. 48, in the table "Summary of Strain-Energy Calculations," the figures in the middle column of the table, for side wires, should have read "714x - 6,420u," and not as printed 714x + 6,420u.

Will readers who wish to have their copies accurate please make the necessary corrections.



TECHNICAL LITERATURE

SUMMARIES OF AERONAUTICAL RESEARCH COMMITTEE REPORTS

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THE APPLICATION OF GOLDSTEIN'S THEORY TO THE PRACTICAL DESIGN OF AIRSCREWS. By C. N. H. Lock, M.A. R. & M. No. 1377 (Ae. 502). (23 pages and 7 diagrams.) November, 1930. Price 1s. 3d. net.

This report contains a summary of a recent paper by Dr. S. Goldstein* and applies the results to the airscrew problem by a method which leads to formulae differing from the standard formulae of the vortex theory only in the addition of a factor to the formulae for the components of inflow; the value of this factor may be obtained from a chart embodying the results of Goldstein's calculations. The formulae of the Vortex theory are developed simultaneously from the first principles by an analogous method which differs somewhat from the method used by its originator and brings out clearly the close analogy with the Prandtl theory of a monoplane wing; they also represent the limit of the Goldstein formulae for the case of an infinite number of blades.

The first application of the results is to show that for a screw of constant geometrical pitch (measured from the zero lift line of the section), a plan form (variation of chord with radius) may be calculated which gives Goldstein's value of the distribution of circulation with radius for all small values of the thrust; the screw is then analogous to the untwisted monoplane wing of elliptic plan form. For the two-bladed airscrews of experimental mean pitch ratio 1.57 and 0.63 the plan form of the family of airscrews approximates closely to the plan form required to satisfy Goldstein's conditions; as the pitch is decreased or the number of blades increased, the required plan form becomes progressively more blunt than that of the family, but the discrepancy between the performance calculated by Goldstein's theory and by the Vortex theory becomes smaller. The discrepancy for the 2-bladed is 14 per cent. for a screw of pitch ratio 1.57, falling to 8 per cent. for pitch ratio 0.63, the value of the thrust according to the Vortex theory being too high.

It is suggested that the Goldstein formulae, which strictly apply only where there is a particular distribution of circulation along the blade, should be applied without this restriction in place of the Vortex theory, at any rate to airscrews of plan form similar to that of the family of airscrews, the extra labour involved being negligible. The modification may also be considered as being of the nature of an allowance for tip loss, since it may be shown that for a blade of constant chord the thrust grading tends to zero at the tip, whereas the Vortex theory gives a finite value of thrust grading at the tip.

* On the Vortex theory of screw propellers.—B. Goldstein, Ph.D. Proc. Roy. Soc. A., Vol. 123, 1929.

THE TORSION AND FLEXURE OF CYLINDERS AND TUBES. By W. J. Duncan, D.Sc., A.M.I.Mech.E. R. & M. No. 1444. (78 pages and 11 diagrams.) February, 1932. Price 3s. 6d. net.

The subjects discussed in the present report are the torsion of solid cylinders and of tubes, and the flexure of solid cylindrical cantilevers loaded at the tip. In many practical instances the section of the cylinder is thin, i.e., the ratio of breadth to length is small; and tubes are almost invariably thin-walled. Hence, particular interest attaches to methods of solution which are specially adapted to thin-walled sections. In the method proposed here the thickness of the wall at every point is taken to be proportional to an auxiliary variable called a "thickness parameter" and a solution in ascending powers of this parameter is sought. When the thickness parameter is varied, a family of sections is obtained, and the solution applies to all the members of the family whose thickness is not too great. In every case the solution for exceedingly thin sections is easily found, and the approximations for the thicker sections are obtained by a process of successive derivation from this initial simple result.

It is not claimed that the solutions obtained are necessarily convergent in the ordinary sense, though this is shown to be true in certain instances. On the other hand, it is proved that the percentage error in any of the approximations tends to zero as the thickness diminishes, and examples indicate that an approximation of quite low order will be sufficiently accurate for practical applications.

The report is divided into four chapters. Chapter I deals with the torsion of solid cylinders of symmetrical section, while solid cylinders of unsymmetrical section are discussed in Chapter II. The mathematical treatment in these two chapters differs considerably. Naturally, the treatment for the unsymmetrical section is applicable to the symmetrical section, but the latter merits separate discussion, as a much simpler analytical method can be used. Chapter III is devoted to the torsion of tubes, and the detailed analysis concerns simple tubes. However, for completeness, there is a brief account of the torsion of built-up tubes having more than one internal boundary. Lastly, the flexure of cylindrical cantilevers is treated in Chapter IV. A question which receives special attention here is the position of the "flexural centre," defined as the point of application of a load which produces pure flexure without twist. The analysis leads to a general formula for the abscissa of the flexural centre which assumes a simple form for very thin sections.

ANALYSIS OF EXPERIMENTS ON THE INTERFERENCE BETWEEN BODIES AND TRACTOR AND PUSHER AIRSCREWS. By C. N. H. Lock, M.A., and H. Bateman, B.Sc.

R. & M. No. 1445. (38 pages and 6 diagrams.) June, 1931. Price 1s. 9d. net.

The present report deals with the analysis of a series of wind-tunnel experiments on a model airscrew housed in three different positions on the axis of a streamline body specified as the tractor, after pusher and forward pusher positions; in the first two positions the diameter of the body at the plane of the airscrew is 0.25 of the airscrew diameter, in the third position it is 0.46.

The data on which the analysis is based are given in R. & M. 1380.* They consist of complete performance measurements with airscrew running for the three airscrew positions, both with the bare body and with an annular ring 0.28 in. deep surrounding the maximum section of the body (body with annulus). The experimental data include direct measurements of airscrew thrust and torque, body drag with airscrew running and the drag of the body without airscrew; also of thrust grading by total head difference through the airscrew disc, and of the pressure distribution over the surface of the body with airscrew running.

Certain simplifications and improvements have been made in the previous methods of analysis given in R. & M. 1120† and R. & M. 1378‡ with the object of obtaining formulae as simple as possible and containing the minimum number of empirical constants which will determine correctly the various observed interference effects between body and airscrew.

The results may be briefly summarised in the following Table. At thrust coefficient of maximum efficiency ($T_c = 0.23$). Components of interference drag expressed as:—

	Per cent. of Thrust		Per cent. of Bare Body Drag	
	Slipstream Drag. A	Spoiling Drag. B	A	B
Tractor position—				
(a) bare body ..	2	24	50	67
(b) with excrescences ..	6	2	50	16
Rear pusher position—				
(a)	0	5½	0	125
(b)	0	3	0	22
Forward pusher position—				
(a)	0	12	0	280
(b)	0	10½	0	85

The theoretical basis of the strip-theory analysis, originally developed in R. & M. 1120, has been restated and shown to apply with little modification to the case of pusher airscrews, the analysis being based on the observed thrust grading curves. The effect of interference on airscrew torque deduced from strip theory agrees with that deduced from the empirical constants, so that the strip theory could be used to calculate the effect for airscrews of different diameters, pitch, etc., at different positions in the nose.

Formulae are also developed for calculating the effect of small changes of pitch and diameter of the screw for its different positions in the body, so as to make the forward speed, revolutions and torque approximately independent of position over the whole working range and to calculate the probable values of the power wastage corresponding to each position. The results were not much affected by these small changes of airscrew characteristics.

* R. & M. 1380. Pressure and force measurements on airscrew-body combinations.—Bateman and Johansen.

† This ring had the effect in the absence of the airscrew of increasing the drag in the ratio of 2.84 to 1, but had little direct effect on the airscrew performance.

‡ R. & M. 1120. Analysis of experiments on an airscrew in various positions within the nose of a tractor body.—Lock.

§ R. & M. 1378. Theory of air-screw body interference.—Lock.

FIRST REPORT ON THE GENERAL INVESTIGATION OF TAIL BUFFETING. By W. J. Duncan, A.M.I.Mech.E., D. L. Ellis, B.Sc., A.R.T.C., and C. Scruton. EXPERIMENTS ON THE BUFFETING OF THE TAIL OF A MODEL OF A LOW-WING MONOPLANE. By R. A. Frazer, B.A., B.Sc., W. J. Duncan, D.Sc., A.M.I.Mech.E., and V. M. Falkner, B.Sc., A.C.G.I. R. & M. No. 1457. (36 pages and 30 diagrams.) February, 1932. Price 2s. 3d. net.

The term "buffeting" signifies the more or less irregular oscillation of some part of an aeroplane (e.g., the tail) produced by the incidence upon it of the eddy wake from some other part. In their report, R. & M. 1360, the Accidents Investigation Sub-Committee of the Aeronautical Research Committee recommended that the phenomenon should be investigated, and systematic experiments on tail buffeting have accordingly been commenced at the National Physical Laboratory. It was thought desirable at the outset to simplify the conditions as far as possible. Hence the investigation has begun with the case where the aerofoil (R.A.F. 31) creating the air disturbance is of infinite aspect ratio. These experiments are described in the first of the two reports published under this cover. The second of the reports gives an account of an independent series of earlier experiments on a complete model of a low-wing monoplane.

The following provisional recommendations are suggested by the authors as a result of their work:—

(a) The tailplane of a monoplane should be placed in the lowest practicable position in relation to the wings.

(b) In view of possible accidental stalling of the aeroplane, the stiffnesses of the fuselage and tail should be such that there is no approach to equality between the predominant eddy frequency at the stall and any of the natural frequencies of the tail.

(c) Anything which would cause premature breakdown of the flow over the central parts of the wings should be avoided. The features which cause premature breakdown are precisely those that promote high drag due to interference between body and wings.*

* See "Interference" by E. Ower. Roy. Aero. Soc., 1932.

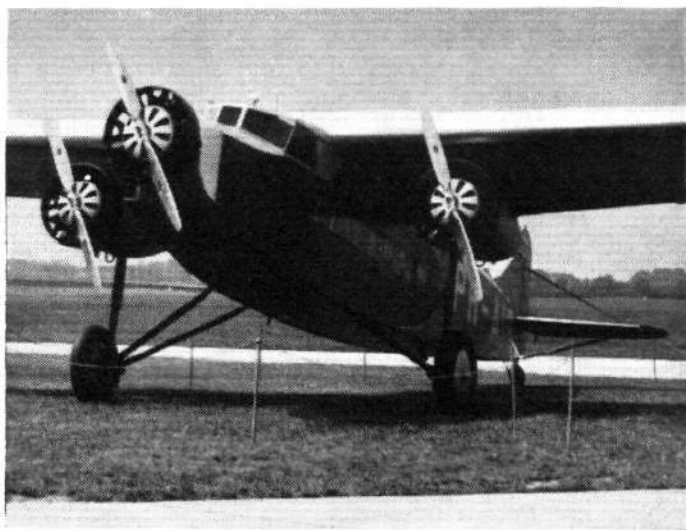
Air Transport

THE FOKKER TYPE F. XVIII.

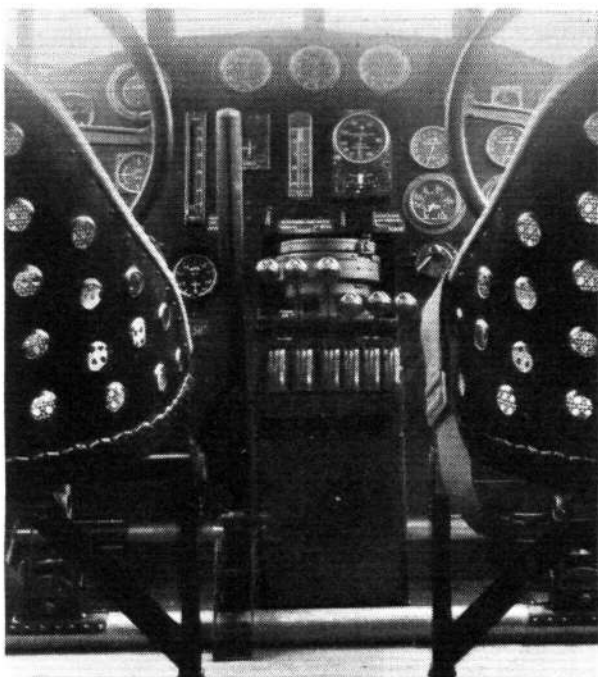
A New Model for the Holland-Dutch East Indies Air Route

DESIGNED specifically for the Amsterdam-Bandoeng air service, the latest Fokker has a long range, a large mail compartment, and very comfortable accommodation indeed for a very small number of passengers. More specifically, the new machine, known as the type F.XVIII, powered by three Pratt & Whitney "Wasps" of 440 h.p. each, has been designed for a range of 930 miles at a cruising speed of 126 m.p.h., carrying a crew of four and a pay load of 1,873 lb.

Five machines of the F.XVIII type have been ordered from the Fokker Works in Amsterdam by the K.L.M., and the first two have been completed and flown, both of them visiting Croydon and Hanworth last week-end. One has been christened the *Pelikaan* (Pelican), while the other has been named the *Oehoe* (Owl). Powered by the same engines, and carrying approximately the same load as the type F.XII, the F.XVIII has considerably greater speed, since it has been found possible to reduce the cabin space and so provide a slimmer fuselage of lower drag. As used on the Amsterdam-Bandoeng air route, the F.XVIII has accommodation for four passengers only, but this is in return of a very comfortable nature, with seats which can be tilted and leg rests raised to form couches. In the forward end of the cabin are seats for wireless operator and the engineer, and a resting place for the pilot who is not on duty. The wireless operator also acts as steward, a pantry with tea and coffee in thermos flasks,



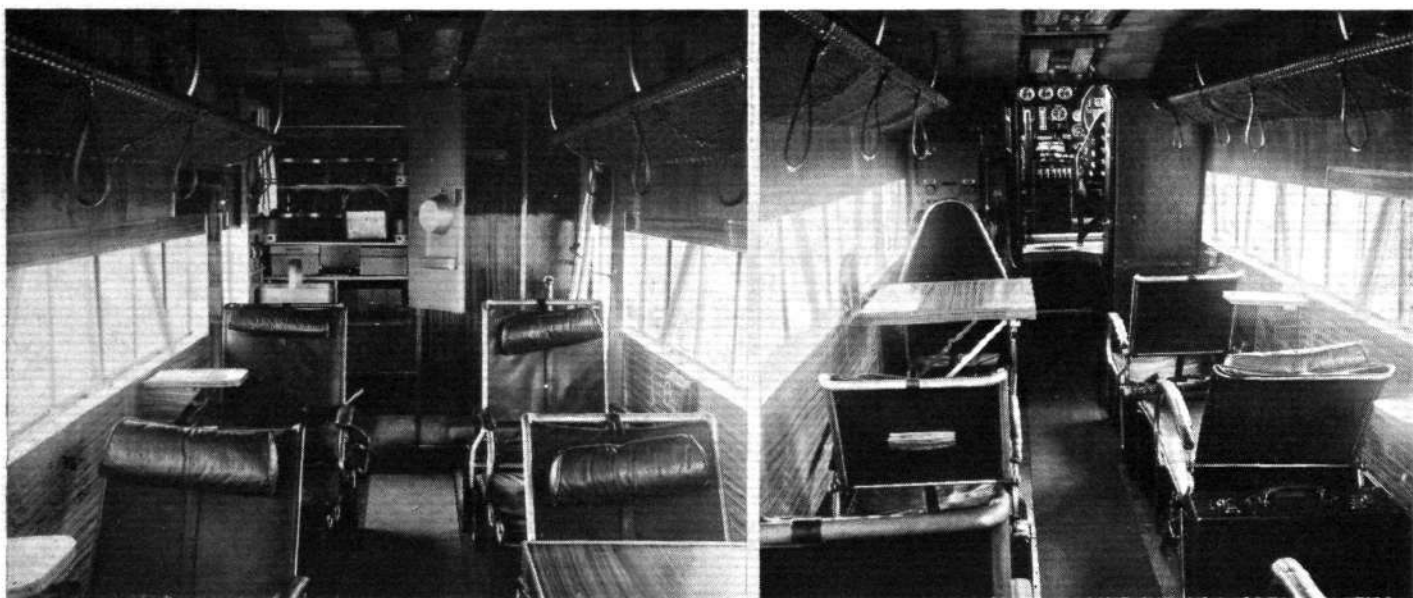
THE FOKKER F.XVIII: The engines are Pratt & Whitney "Wasps" of 440 h.p. each. They are fitted with Townend rings. (FLIGHT Photo.)



ON THE LEFT: Looking into the pilots' cockpit. The circles on the backs of the seats are lightening holes and not instruments! (FLIGHT Photo.)

BELOW: Three-quarter front view of the Fokker F.XVIII. (FLIGHT Photo.)





IN THE CABIN OF THE F.XVIII: On the left a view looking aft. Note the pantry, of "easy work" style. On the right a view looking forward. The seats can be turned into couches. The table on the left is the navigator's chart table. (FLIGHT Photo.)

iced drinks, bread, fruit, etc., being installed in the aft end of the cabin.

In general design and construction the Fokker F.XVIII follows usual Fokker practice, with welded steel tube fuselage and three-ply wooden wing. The "Wasp" engines are fitted with Townsend rings to reduce drag. The petrol tanks, housed in the wing, have a total capacity of 442 gallons, which suffices for stages of 930 miles at a cruising speed of 126 m.p.h. The maximum speed of the machine is 152 m.p.h., and the minimum speed about 70 m.p.h., the endurance at cruising speed being a little over 7 hr.

The tare weight of the F.XVIII is 9,587 lb., and the disposable load 7,053 lb., giving a gross weight of 16,640 lb., so that the ratio of gross to tare weight is 1:737.

The main dimensions are: Length o.a., 60 ft. 8 in.; wing span, 80 ft. 10 in.; wing area, 904 sq. ft. The cabin has a length of 19 ft. 4 in., a width of 5 ft. 4½ in., and a height of 6 ft. 1 in., giving a capacity of 600 cu. ft. If the machine is used for shorter stages, accommodation can be provided for 13 passengers.

Actually the *Oehoe* has been so equipped, and a very fine passenger accommodation has been provided.

OPERATIONS IN SIAM

THE Aerial Transport Company of Siam, Ltd., which was organised to become an aerial link in the Europe-China air traffic, was able to present to its shareholders at its annual meeting on June 14 a balance sheet showing a net profit of Ticals 3,400.67 as the result of its first seven months' operation. This is a net profit of 9.14 per cent. on its overall expenditure of Ticals 37,195.41, which includes the sum set aside for depreciation. The balance was struck as of March 31, which is the close of the Siamese calendar year. The Tical during this seven months period was on the gold basis and was worth 43 gold cents.

This particular operation was a 620-kilometre route from the railhead at Korat, the second largest city in Siam, across the jungle in North-east Siam to the Indo-China frontier. It was undertaken while marking time waiting for the completion of the aerodromes between Rangoon in Burma and Hanoi in Indo-China, and for the inauguration of the service between Hong Kong and Hanoi. This flight from Rangoon to Hanoi will cut time between London and Hong Kong to 12 days, on the present operating schedules of the K.L.M. (Dutch), Air Orient (French) and Imperial Airways (British). When the schedules from Europe to Rangoon are reduced, the time to Hong Kong and Canton will be cut still further.

As pointed out by the Chairman of the Board of Directors, the total revenue for the seven months period was Ticals 40,596.08 and the total expenditure was Ticals 37,195.41. This made a cost of Ticals 78.18 per hr., or 52 satang per kilometre. This is equivalent to \$33.62 gold per hr., or 36 gold cents per mile. Of the total expenditure during the seven months period Ticals 19,508.71, or 52 per cent., was for wages, commissions and salaries, and Ticals 12,288.08, or 33 per cent., was for supplies, repair parts, fuel and oil. Depreciation was fixed on the basis of 1,500 hr. as the life of the motors and 2,000 hr. as the life of the airplanes. Full insurance was carried by the company on all its equipment on the ground and in the air.

Mail is the principal traffic of this feeder line, it being carried at the rate of 1 satang per kg. per km., and equivalent of about ¼ cent per pound-mile or about \$1.80 per pound between New York and Chicago, or Paris-Copenhagen. This rate saves the Post Office Department approximately Ticals 30,000 per year, against what it would have cost the department to have continued its contract with the Army Air Force.

It is expected that the Hong Kong-Hanoi operation will be inaugurated this fall. In the event of delay beyond that period, it is proposed to utilise the 44-hr. steamship service between Haiphong and Hong Kong. As soon as the Rangoon-Hanoi line of the Siamese Company is in operation, the present mail line of the Aerial Transport Company of Siam, Ltd., will become a feeder line to the main operation from Bangkok.

The Siamese air line was created and developed under the direction of His Royal Highness Prince Purachatra, Minister of Commerce and Communications, who assigned the task of working out the details of the plan to Otto Praeger, who as Assistant Postmaster-General of the United States, established and directed the operations of the United States transcontinental air mail from 1918 to 1921. After a careful survey of traffic possibilities a combination of domestic and international operations was devised, and the company went into operation on its feeder line on August 22, 1931. The equipment of this feeder line, which consists of "Puss Moth" planes with 125-h.p. inverted Gipsy engines, and which can carry a net payload of practically four pounds to the horse-power, was designed to carry the probable volume of traffic and no more, it being more economical to operate occasional extra planes than to operate continuously partially filled large machines. The planning, the budgeting, the excellent supervision in the field, and particularly the splendid work of the Siamese pilots and Siamese mechanics, has enabled the company to go through the rainy monsoon without a forced landing, accident of any kind, or default of a single leg of the route in seven months' opera-

tion, and has made possible the first year's balance sheet showing of a net profit despite the depression and the extra expenditures incidental to the initial stages of a new operation.

Except for Otto Praeger, the Managing Director, and R. B. Jackson, the Field Operations Manager, the personnel of the company is 100 per cent. Siamese. The Siamese make ideal pilots for commercial work. They are not given to grandstand displays, and their respect for law and order is such that they take no unauthorised chances with the property entrusted to them, while the mechanics are skilful, and with good supervision, make a reliable and dependable working force.

The company was organised with a capital of 600,000 Ticals, but it has been necessary to call in only one-fourth of the amount subscribed. Speaking of the strength of

the company, Phya Chao Vananusthiti, the Chairman of the Board of Directors, was able to say to the shareholders: "The strong position of the Aerial Transport Company of Siam, Ltd., is shown by the fact that the assets include Ticals 48,276.11 in cash, and Ticals 37,061.54 in accounts receivable, practically the entire sum of which, in fact, was collected shortly after the close of the year B.E. 2474. As will be seen from the balance sheet, the receipts of the company from all sources aggregated Ticals 40,596.08 while the total expenditures, including Ticals 4,360.52 for depreciation, according to the generally accepted basis of 1,500 hr. as the life of the motor and 2,000 hr. as the life of the plane, aggregated Ticals 37,195.41, leaving a net profit of Ticals 3,400.67 for the seven and a-quarter months' operation, or a surplus of receipts over all expenditures of 9.14 per cent."

The London Chamber of Commerce and Air Mail Development

It is now over a year and a-half since the London Chamber of Commerce, on the recommendation of its Civil Aviation Section, made representations to H.M. Post Office on a number of matters affecting the Air Mail services and Postal Regulations. In February, 1931, a combined air fee and postage rate was announced for letters to countries outside Europe, similar to the arrangement which already existed for letters to the Continent. Apart from this, however, no action has been taken in connection with the Chamber's proposals. It will be remembered that a reduction in the minimum unit of weight for air mail letters was advocated and also a general speeding-up of air mail services. Moreover, it is felt that a great deal more could be done by way of publicity to encourage a more general use of the Air Mail. The business community is very perturbed at this state of affairs, and the Chamber is pressing for a reconsideration of its proposals with the object of extending the facilities of air mail services and increasing their utility to the public.

Bristol-Cardiff Air Service

THE demonstration service operated with the Fokker *Spider* between Bristol and Cardiff concluded on July 17. This service was operated for one week as an experiment with the object of securing first-hand information as to the demand for such a facility, and also to discover the possibilities of maintaining the service regularly on an economic basis. Considering that the weather conditions were not good, it can be said that the result was entirely satisfactory. During the week the *Spider* made forty return trips from Cardiff to Bristol and 199 fare-paying passengers were carried, exclusive of a limited number of complimentary tickets which were issued. The aeroplane maintained its scheduled time on each journey, and it was found that business increased as the week progressed to such an extent that on the Saturday two extra trips had to be made to deal with the passengers. The British Air Navigation Co., Ltd., who were responsible for the service, are satisfied as to its possibilities, and negotiations are in hand with this company for the establishment of a regular service some time in August. The majority of passengers making use of the ferry were West of England and South Wales business men, all of whom were well satisfied with the time saved through making the journey by air.

The Vickers "Viastra" in Australia.

THAT West Australian Airways are pleased with the behaviour of the Vickers "Viastra" may be gathered from the following extract from *Airways Bulletin*: "Built for speed, and built for comfort," might well be the slogan of the 'Viastra' air-liners in W.A. Airways service, the design of which has proved beyond shadow of doubt that they are able to meet all conditions. Perhaps the most striking demonstration of the ability of these luxury air-liners was made during the abnormal weather conditions encountered during the end of May. Cyclonic conditions prevailed; the wind whistled and shrieked as it drove the rain before it; the sky was black with scudding clouds and the Observatory instruments showed that wind velocities of over 60 miles an hour were recorded; shipping services were held up, including the great ocean-going mail steamers, yet the 'Viastra,' racing into the teeth of this westerly gale, covered the 750 miles from Forrest to Perth within two hours of her allotted schedule and completed the most difficult stage—between Kalgoorlie and Perth—against the most severe weather conditions in less than four hours, and it has to be remembered that the serious delays to ocean-going liners were also shared by the railways due to washaways on this occasion. The

return journey to Adelaide was made under calmer conditions and with favourable winds. These added to the high speed normally possessed by the 'Viastra,' so that the journey to Adelaide was completed in 10 flying hours, or an average speed of 145 miles an hour for the transcontinental journey. The longest stage of 400 miles between Kalgoorlie and Forrest was covered at an average speed of 155 miles an hour. On both these journeys a full complement of passengers was carried, and the usual radio communication was maintained."

Beit Railway Trust, Rhodesia

At the request of the Southern Rhodesian Government £11,000 of the grant of £50,000 to assist aviation in Rhodesia, made by the Beit Railway Trust, will be spent immediately to lay out emergency landing fields along the Imperial Airways route and to extend existing aerodromes. The work is being rushed so that air travel during the wet season will be made safe.

Belgium-Congo Air Mail

It is reported from Brussels that Sabena proposes to open a service between Antwerp, Brussels and the Congo, starting on October 1. The service will run twice a month in each direction, Sabena-Europe controlling the section Antwerp-Gao, and Sabena-Congo the section Gao-Leopoldville. Only correspondence will be conveyed at the outset. The stages proposed are Antwerp, Brussels, Marseilles, Barcelona, Alicante, Oran, Gao, Fort Lamy and Bangui. As a French service is also to be organised, there will be weekly air mail communication between Belgium and the Congo.



FOR THE CLYDE-BELFAST SERVICE: The Saro "Cloud" amphibian of British Flying Boats, Ltd., being christened *Cloud of Iona* by the Duchess of Hamilton—supported by Mr. John Lord and Sir Alliott Verdon Roe—at Cowes. As previously reported in "Flight," B.F.B., Ltd., will operate services between the Clyde and Belfast, and in other parts of Scotland. The service to the Isle of Man, previously planned, is for the moment held up pending arrangements for landing at Douglas, where British Amphibious Air Lines, Ltd., hold sole landing rights in the Bay in connection with their service between Liverpool and the Island.

Airport News

CROYDON

THE chief attraction of the week was the new Fokker XVIII's, two of which arrived last Saturday from Amsterdam for a special show given to the English agents of the Royal Dutch Airlines. One was fitted out for service on the East Indies route, and the other for European air lines. Full details are given elsewhere in this issue, so I will not attempt a description, but the beauty and finish of these machines was the subject of favourable comment all round. To give "atmosphere" to the show, a party of six or seven Dutch ladies were brought over in one of the machines, dressed in the full Dutch national dress, and they were to be seen mingling with the crowd. About 150 of the agents were given flights during the afternoon.

General Higgins, the Salvation Army Chief, and his wife left on Friday morning by K.L.M. *en route* for Denmark. It is understood this is the first occasion anyone connected with this body has used the airways in an official capacity.

Air transport has again proved its great advance over ordinary means of transport this week. Mon. Georges Seversky, a singer, appearing nightly on the "Showboat" in London, is also engaged for a season to appear during

the afternoon at Deauville. The only way of fulfilling both engagements is by aeroplane, and being a pilot himself, he has hired a "Moth" for the season, and every day about 12.30 he can be seen taking off for Deauville, accompanied by his pianist. He usually returns about 8 p.m., in time for his London engagement. This is probably a record distance to cover for a double engagement, and we must congratulate him on his up-to-date complex.

A load of several hundred homing pigeons were carried through the night from Hanover on Friday, arriving at Croydon early Saturday morning. They were released from their baskets at 8.30 a.m., and immediately got on a direct course back to Germany.

The week-end weather proved a "wash-out," in more ways than one, by keeping most people indoors, the joy-riding people doing, therefore, comparatively little business.

Capt. Shran paid us a visit during the week with the Comper "Swift" fitted with a Cirrus engine.

Mr. Percival has also been putting the "Gull" through its paces, and gave us an exhibition of aerobatics.

Traffic figures for the week:—Passengers, 2,412; freight, 69 tons. P. B.

FROM HESTON

SUNDAY, July 17.—Night flying commenced punctually at 10 p.m. and was carried on continuously with two machines up to 12.30 a.m. There is no doubt that it is gaining in popularity, and from the numerous requests to be taken over London it is evident that viewing the lights is worth the adventure.

Monday.—Capt. Barnard, for Banco's, was off at 7.30 a.m. to Berck with "The Spider," and returned with a full passenger list at 10.20 a.m., making another journey at 5 p.m., arriving back at Heston at 8.20 p.m.

Tuesday.—Banco had a "Puss Moth" off to Berck early and returned with two passengers. In the afternoon G-ABGD left for Ostend with Mr. Michael Wombwell and Miss Joy Oakley—niece of Lord Ducie—who were married to-day, on their honeymoon. Mr. Meny ("Puss Moth") arrived from St. Ingelvert. Mr. H. B. Chantrey qualified for his "A" licence. The hours of instruction given on Airwork School of Flying machines to-day eclipsed all previous records this year, instruction being given continuously up to 9 p.m.

Wednesday.—Mr. G. Downes-Martin and his bride (the missing airman of last week) arrived back at Heston in his "Klemm." Miss Winifred Spooner arrived from Milan in "Breda 33"—G-ABXK. The Marquis of Donegall qualified for his "A" licence.

Thursday.—Lt. Robert Hirszbandt, of the Polish Air Force, arrived at Heston in SP-ADG, Polska Spadg. Lord Churston made his reappearance at Heston after a long absence and hopes to resume his flying activities in the near future. Mr. J. T. T. Fletcher, Welsh Guards, qualified for his "A" licence. Lady Hay-Drummond-Hay departed for Amsterdam and Berlin in her "Puss Moth." Mr. Necoleco left for Paris in "Puss Moth" G-ABLO, of which he had just taken delivery at Stag Lane. Mr. and Mrs. Meny left for St. Ingelvert in their "Puss Moth."

Friday.—The Visct. Maldon, son of the Earl of Essex, qualified for his "A" licence to-day, also the Lady

Howard de Walden. Mr. George B. Ismay made a successful first solo flight. Banco had one charter to Stoke-on-Trent to pick up Brig.-Gen. A. C. Critchley, and one to Teignmouth with the Marquis de Casa Maury. Mr. Christopher Clarkson, manager of Selfridges, Ltd., Aviation Department, left at 7.30 a.m. for Zurich in Comper "Swift" G-ABPE, and Mr. Bulman in a Hawker "Hart" to Paris. Mr. Sear, with one passenger, arrived from Paris in VP-KAR ("Moth," Gipsy III). Mr. Carberry arrived from Berck in D-2299 ("Klemm" fitted with cabin top).

Saturday.—Seven machines left Heston to-day for the meeting at Deauville: Mr. Chantrey ("Avian"), Mr. Cantrill ("Avian"), Mrs. Markham ("Avian"), Mr. Rex Hayter ("Puss Moth"), the Hon. Drogo Montagu ("Klemm"), and a Comper "Swift" of Banco. A large party, numbering over 150, from the Hounslow Central and Hounslow West Ward Ratepayers' Association visited Heston this afternoon. Two "Puss Moths" were busily engaged for several hours in meeting the demand for joy rides. Whilst the party was at tea Mr. Nigel Norman, with the aid of the loud speakers, addressed the gathering, welcoming them to the Airport and thanking them for their attendance, and Mr. Denman followed by explaining the movements of different machines in the air. Capt. Baker gave an exhibition of crazy flying, and Henlys, Ltd., provided a machine and pilot to give an aerobatic show. The Countess of Haddington had the pleasure of taking her husband for a flight, he being her first passenger.

Sunday.—Brig.-Gen. A. C. Lewin, A.D.C. to the King, was early astir and was flying a "Puss Moth" soon after 8 a.m. He is staying at the hotel on the Airport in order to put in some early morning flying. We should like to remind private owners that it is possible to obtain a drawback on petrol when clearing Customs at Heston for abroad. The members of the Panther Motor Cycling Club visited Heston to-day.

Customs at Dublin

AIR MINISTRY Notice to Airmen Series A. No. 45 of 1932 is a notification that a civil Customs aerodrome for public use has been established at Kildonan, 4½ miles north-west by north of Dublin. The same notice also advises pilots of the procedure to be carried out for reporting their passage across the Irish Sea between Holyhead and Baldonnell or Kildonan aerodromes.

Another Municipal Aerodrome

LEICESTER is one of the latest cities to definitely

embark on arrangements for the provision of a municipal aerodrome, and within twelve months it is hoped that this aerodrome will be established at Braunstone. When this is an accomplished fact it is more than probable that the Leicestershire Aero Club will move from Desford.

—And Another

HASTINGS TOWN COUNCIL has decided to buy a large farm situated at the western boundary, adjacent to Bexhill, for the purpose of establishing a municipal aerodrome at a cost of over £10,000.

Airisms from the Four Winds

The Zurich Meeting

A 10-DAYS' flying meeting, extending from July 22 to July 31 is at present being held at Zurich. The programme includes events for private machines, commercial aircraft, and military types, and is divided into a national and an international section. Of the events of which results are available, the most interesting so far have been the international military contests. One of these consisted in a speed race around a triangular circuit, with start and finish at Zurich (Dübendorf aerodrome) with turning points at Thun and Bellinzona. The total distance is one of 367 km. (228 miles), and the course was so laid out that competitors had to cross mountains some 12,000 ft. high. The race was for machines in two categories: single-seaters and two-seaters, and was confined to military types. Great Britain did well in both categories, the winners in both classes being British aeroplanes. In the single-seater class, first place was secured by the Yugoslav pilot, Capt. Sintic, on a Hawker "Fury" (Rolls-Royce "Kestrel") belonging to the Yugoslav Air Force. His time for the circuit was 68 min. 38 sec., corresponding to an average speed of 201 m.p.h. Sintic did not cross the finishing line properly and had to make a circuit of the aerodrome, whereby he lost considerable time. Second place was gained by a Polish PLZ 11 monoplane with "Mercury 4" engine, whose time was 71 min. 10 sec., corresponding to a speed of 193 m.p.h. Third was a French "Dewoitine" with 500-h.p. Hispano. Its time was 75 min. 33 sec.; speed 181 m.p.h. In the two-seater class first place was secured by the Belgian pilot, Capt. Vanderlinden, on a Fairey "Fox" (Rolls-Royce "Kestrel"). His time was 85 min. 46 sec. and his speed 160 m.p.h. Second was a French "Potez 50" with Hispano engine. Time, 85 min. 50 sec. Speed, 159 m.p.h. Third was a French "Breguet XIX" (Hispano). Time, 87 min. Speed, 157 m.p.h. Another "Potez 50" fitted with the new Gnome-Rhone K.15 engine flew the course, although not entered, and thus not competing officially. Its time was 79 min. 10 sec. Speed, 173 m.p.h. It is gratifying that British aircraft should have secured first places in both classes, and that both should be fitted with the Rolls-Royce "Kestrel" engines. Both were also doped with Cellon.

Herr Gronau Crosses Atlantic Again

HERR WOLFGANG VON GRONAU—who in 1930 and 1931 flew from Germany to America via Greenland—left Borkum Island on July 22 on a similar flight in a "Dornier Wal," accompanied by Herr G. von Roth (second pilot), a mechanic and a wireless operator. Seydisfjord, Iceland, was reached the same evening, and they went on to Rykjavik next morning. Proceeding on July 24 they landed at Ivigtut, Greenland, in the evening, and early on July 26 landed at Cartwright, Labrador. They took off again later for Montreal.

Solo Around the World

FLYING a Lockheed "Air Express," fitted with a Pratt & Whitney "Wasp" engine a young American pilot, Thomas Ash, Jun., hopes to beat the record of 8½ days set up last year by Wiley Post and Harold Gatty for a flight around the world. Flying solo from New York, Ash plans to fly over Nova Scotia and Newfoundland and then via the Great Circle course to Ireland, which he hopes to touch at Donegal Bay. His first stop will be Cranwell, Lincolnshire, and then on to Omsk, Siberia; Nome, Alaska; refuelling for the final hop at Edmonton, Canada. No definite date has been fixed for his departure from New York, but it is expected to be at the end of the present month or early in August.

Schneider Seaplane for Canada

THE Vickers-Supermarine S.6B. (Rolls-Royce "R" engine), which won the Schneider Trophy for Great Britain, was shipped from London on July 22 for Toronto, where it will be exhibited at the 54th Canadian National Exhibition next month.

Farman "Stratospheric" Aeroplane Tested

THE French pilot Lucien Coupet carried out the first flying tests of the Farman "Stratospheric" monoplane at Toussus-le-Noble on July 21. This machine, with which it is hoped to attain an altitude of over ten miles, was described in FLIGHT for June 26, 1931.

Cruise by No. 202 (Flying Boat) Squadron

FOUR Fairey 3F floatplanes of No. 202 (F.B.) Squadron, which is stationed at Malta, have just completed a four

weeks' cruise in the Mediterranean under the command of Sqd. Ldr. H. W. Evens. The route covered Malta, Corfu, Athens, Kestelozio, Famagousta, Beirut, Aboukir, Luxor, Dongola, Khartum, back to Kestelozio, Mirabella, Athens, Corfu, and Malta.

A Baghdad Flying School

It is reported from Baghdad that the Iraqi Government intends to open a flying school there for training Iraqi officers. British factories have been approached as to the supply of training aeroplanes, and Sqd. Ldr. Warburton has been sent to London to make arrangements.

Coast Defence of Great Britain

THE War Office on July 25 issued details of a scheme whereby the coast defence of Great Britain will be entrusted to the Territorial Army. The scheme includes the provision of the necessary anti-aircraft units either by the conversion of existing coast defence units or by the conversion of field and medium artillery batteries suitably placed for immediate manning duties in war. All ranks will in future be required to sign an agreement to come up for service as and when required.

S.A. Air Force on Active Service

THE South African Government have ordered three aeroplanes of the S.A. Air Force to fly from Pretoria to Windhoek to take part in a punitive expedition against a native chief in Ovamboland, South West Africa. Col. Sir Pierre Van Ryneveld is in command of the aircraft.

Irish Air Lines

JOYRIDING, charter work and instruction at country towns throughout the Irish Free State is being carried on very energetically by the youngest body in Irish aviation, Irish Air Lines, Ltd. The equipment consists of two Avro 504 K's and a Blackburn "Bluebird," and it has been found that the "chumminess" of the latter machine is very popular with joyriders. Already more than 30 centres throughout the country have been visited, and at present the fleet is based at Waterford, its headquarters.

High Speed Boats for the R.A.F.

THE British Power Boat Co., of Hythe, Southampton, has recently delivered two special coast-cruising high speed "Power" boats to the R.A.F. These were designed and constructed in a few days under fourteen weeks, and, despite the exceptionally severe trials to which they have been subjected, have not necessitated any modifications whatsoever. They are triple screw boats with peculiarly light steering devised by Mr. Scott Paine, the owner of the company. A further feature is their unsinkability due to a form of construction which does not make use of air tanks. When delivered both these craft left Southampton for the N.E. coast some 450 miles distant and made the journey in only 15 hr. running time.

Transatlantic Communications

ANOTHER step in the speeding up of transatlantic communications was made recently when Mr. Maxwell Ayrton, the famous architect, accompanied by Mr. C. H. Clendinning, Director of the Irish Transatlantic Corporation, an Inspector of the Irish Lands Commission, and the Galway Harbour Engineer, visited Furbough, six miles from the city of Galway, to select a site for an airport to link transatlantic steamer services with the Continent by air. It is the intention of the Irish Transatlantic Corporation, if they can secure the necessary co-operation from the British, Free State and Canadian Governments, to establish a port of call at Furbough for liners. Passengers and mails will then be taken by car to the site of the airport, some two miles distant, and travel to their destinations in Europe by aeroplane.

National Aviation Day Displays

DISPLAYS in connection with Sir Alan Cobham's National Aviation Day Campaign will be held as follow:—August Bank Holiday, Sunday and Monday, July 31 and August 1.—Ramsgate; Nethercourt Flying Ground, London Road. August 2-3.—Eastbourne; Frowd's Flying Field, King's Drive. August 4.—Horsham; North Heath Farm. August 5.—Reigate; Rookery Farm, Lower Kingswood. August 6 and 7.—Brighton; Shoreham Aerodrome. August 8.—Littlehampton; Ford Aerodrome, Yapton. August 9.—Bognor; Chalcraft Farm, North Bersted. August 10.—Portsmouth; Municipal Airport. August 11.—Southampton; the Municipal Air Park, Atlantic Park, near Eastleigh. August 12 and 13.—Bournemouth; Castle Lane, near Iford Bridge.

The Industry

A GUIDE TO AERODROME LIGHTING

THE British Standard Institution, of 28, Victoria Street, S.W.1, have recently published a pamphlet, price 2s. 2d. post free, entitled "A Guide to Aerodrome Lighting." This is arranged with the approval of the Air Ministry and is preparatory to the publication of a British standard specification. It seems somewhat early to lay down the law in an arbitrary fashion as to the requirements for aerodrome and airway lighting, but there is no doubt that the establishment of a standard should greatly assist the development of commercial aviation along economical lines. The committee's recommendations as regards aerodrome location beacons, aerodrome boundary lights, aerodrome wind indicators, obstruction lights and landing lights do, as they point out, go beyond the existing regulations, the reason being that these regulations were drawn up immediately after the war and before civil aviation activities had really commenced. By these recommendations it is intended to anticipate as far as possible international practice of the future.

FLYING AND BUSINESS

THIS month's *Petters News*, the house organ of Petters, Ltd., and the Westland Aircraft Co., contains details of an interesting trip made by Mr. Haywood, their representative for Central America. This gentleman travelled over 9,000 miles in Venezuela, Columbia, Mexico, Cuba, Jamaica and the whole of Central America in under three months. The success and rapidity of his journey was solely due to the use of aircraft whenever this form of transport was available.

VICKERS IN CANADA

THE Vickers Supermarine Rolls-Royce S.6B. seaplane has been shipped to Canada, where it will be shown during the Canadian National Exhibition at Toronto in August. Another interesting exhibit in the section of the exhibition devoted to Vickers' interests will be a model of the Vickers "Vimy" Rolls-Royce aircraft in which Sir John Alcock and Sir Arthur Whitten-Brown made the first direct Trans-Atlantic flight on June 14-15, 1919. A special brochure is to be issued at the exhibition on behalf of Vickers, Ltd., and Associate Companies, which forms a very attractive catalogue of the main productions of this vast organisation. Three pages are devoted to aviation, on two of which the "Viastra" forms the main subject matter, while on the third reference is made to their subsidiary, the Airship Guarantee Company, which built R.100. In view of the importance to British aviation of large flying boats, the Vickers Supermarine products are naturally of great interest to our Dominions, and some reference will be found to the boats made by this firm on the second page devoted to aircraft.

HOFFMANN BALLBEARINGS

HOFFMANN ballbearings were again used in every single aero engine of the King's Cup race, and also in the engines and gear box of Lord Wakefield's *Miss England III* in which Mr. Kaye Don has recently broken the world's water speed record with a speed of 119.81 m.p.h. Those wishing to do business with this firm should note that the works will be closed from 5 p.m. on Friday, July 29, until Wednesday, August 9. The Offices and Despatch Department will, however, open on Tuesday morning, August 2, and a small staff will be in attendance on Saturday morning to deal with urgent orders.

A NEW FLAME TRAP

FIRES have on many occasions been caused in aircraft by a flame blowing back through the carburettor air intake. Of particular interest is the new "Amal" Flame Trap, which entirely eliminates any risk of blowing back when it is attached to the air intake. Amal, Ltd., the makers, are a subsidiary of Imperial Chemical Industries, Ltd., Millbank, London, S.W.1, and this flame trap of theirs is a cup-shaped attachment containing a flat corrugated ribbon of special non-corrosive metal wound in the form of a flat spiral. The series of small triangular tunnels thus left entirely prevents the passage of any flame, while at the same time admits the air freely. This trap has been approved and adopted by the Air Ministry for use on passenger-carrying aircraft, and a further modified form has been produced as suitable for marine engines, to eliminate the risk of fire in motor-boats.

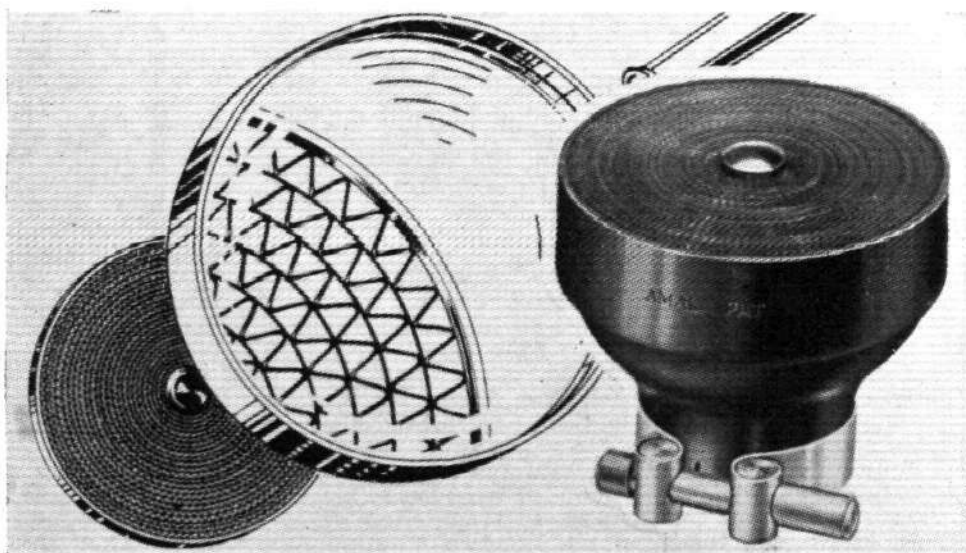
IN THE CAUSE OF WELDING

JUDGING by the amount of literature on welding received by FLIGHT recently, there is clearly a campaign to advance the utility of welding. "Sif-Tips" is a new quarterly house

journal, published by the Suffolk Iron Foundry (1920), Ltd., of Stowmarket, and intended to give hints and tips for the welder of to-day. It is an unpretentious small journal in style and appearance, but its contents are practical and sound. To explain the possibilities in the difficult process of welding cast iron is one of the special aims of the publishers, and in one article it is pointed out that success in this class of work depends to a great extent on the amount of knowledge possessed by the welder as regards the composition and mechanical characteristics of this metal. Companion literature to "Sif-Tips" is "Acetylene Flames," published by the Acetylene & Welding Consulting Bureau, Ltd., Grand Buildings, Trafalgar Square, W.C.2. This Bureau is engaged in the task of keeping abreast with all the advanced developments in the application of welding, both abroad and at home, and spreading information collected for the benefit of those concerned. They have a workshop wherein practical demonstrations are given, and they show films periodically for all interested in the subject. Their present booklet is issued as a simple guide, mainly for students. It mentions, incidentally, of Duralumin, that it is an aluminium alloy suitable for welding, but requiring subsequent heat-treatment in order to develop its strength. A pamphlet is also issued by this Bureau giving a description of an important innovation in oxy-acetylene welding, for which it is claimed that the speed of welding can be increased 50 to 60 per cent., reducing the cost by 25 to 30 per cent. at the same time. The Keel Multi-Flame Blowpipe is responsible for this increase, and it incorporates the right-hand (or backward) welding method which was introduced a few years ago and increased welding speed by 30 to 40 per cent. Part of the Bureau's present policy is to try to advance the practice of the right-hand welding method in this country.

SPRAY-PAINTING PLANT

TO meet the demand for a full-capacity spray-painting plant from users who have not sufficient



The new "Amal" Flame-Trap for carburettor intakes.

work to keep a larger plant continuously occupied the Aerograph Co., Ltd., have produced a model designated as Type A.D. It is a portable unit, small and therefore easy to handle, and there is an electric model and a petrol model, the latter costing slightly more. It accommodates a standard Aerograph spray gun, and is particularly useful in a mass-production factory for dealing with urgent work that cannot conveniently be done with the main spraying plant.

The secret of successful spraying is largely contained in the application of even pressure. In its capacity for operating a standard spray gun, Type A.D. model represents a successful solution to the problem of how to provide an air compressing outfit producing the necessary uniform pressure for such a gun at a low price and of reasonable proportions.

This new unit consists of a petrol engine (or electric motor), air compressor, air receiver, moisture and oil separator, chassis and drive, and the spray-painting equipment. The petrol engine is 1.3 h.p., single cylinder, two stroke, consuming 1.3 pints per b.h.p.-hour and 0.04 pint of oil per b.h.p.-hour. It is lubricated by the simple petrole system, the proportions of the fuel being a quarter of a pint of oil to one gallon of petrol. The engine is hopper-cooled and a centrifugal governor is fitted to control the carburettor throttle.

Ignition by flywheel magneto provides easy starting and running under all conditions.

For the electric model the motor used is of 1 h.p., complete with a length of cable and plug adapter.

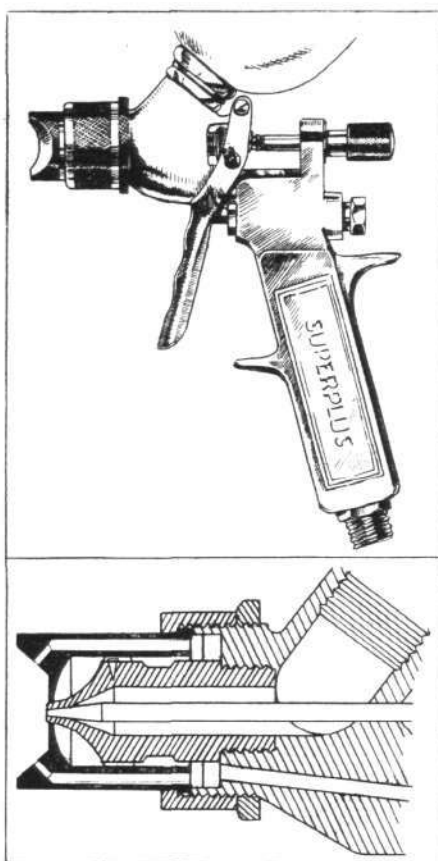
The air compressor is of a vertical single-acting, twin-cylinder type, air cooled, with aluminium pistons, drop-forged duralumin connecting rods, and crankshaft of the best-quality steel. The valves are of the flat disc type made from special non-rusting valve steel. The displacement at 960 r.p.m. is 6.98 cu. ft. per min., providing ample capacity for the continuous operation of a full-size Aerograph spray gun without drop in pressure.

The air receiver is a steel tank with stoutly-welded seams, fitted with safety valve, pressure gauge and drain cock. It is tested to a pressure of 100 lb. per sq. in.

As compressed air always contains an amount of moisture, oil and dirt, which must be removed to ensure a satisfactory finish when spraying, an Aerograph Type M.C. separator is therefore fitted to the outlet of the air receiver. A supply of clean dry air at the spray-gun is thus made certain. The interior filters can be very quickly changed. The chassis carrying this equipment is a steel trolley fitted with a convenient push-bar. Two of the four wheels are of the roller-bearing swivelling type, providing easy movement and control.

With the Superplus spray-gun, which is supplied as standard, is a half-pint colour container, which can be cleaned quickly when a change of colour is required, and a 25-ft. length of $\frac{3}{8}$ -in. air hose, giving ample working radius from the plant.

Normally, a spray-gun should operate at a pressure of from 35 lb. to 45 lb. per sq. in. By simply turning



The Aerograph "XL Superplus" spray gun with a readily detached colour container making rapid changes of colour an easy matter.

the air cap with the fingers the gun should produce either a wide fan spray for large surfaces or a round concentrated spray for smaller surfaces, an absolutely uniform pattern being obtained in both cases. The flow of material is controlled by a needle valve seating in the nozzle of the gun with perfect accuracy. This needle valve permits the operator to start and stop the flow of colour gradually, and to apply a thick, thin or medium coating by simple manipulation of the trigger of the gun. It also prevents the risk of spitting or dripping, and is indispensable for working round mouldings of motor-car bodies and similar work. To show the variation possible with a gun fitted with a needle valve, marred spots the size of a small coin can be touched up and, in the other extreme, a band of paint can be applied 4 in. to 8 in. wide at each stroke. It is reasonably claimed that from 40 to 50 sq. yd. per hr. can be perfectly painted with a spray-gun by one man, while much higher speeds of work are commonly attained. A gun must produce a soft, perfectly-atomised wet spray, with the material evenly distributed over its entire area.

The Aerograph Co., Ltd., have city offices and showrooms at 43, Holborn Viaduct, E.C.1, where an interested visitor may inspect several types of their plant. (Tel. Holborn 1257-8-9.)

AVIATION AND THE AUTOMOBILE ASSOCIATION

THE 27th Annual Report of the Automobile Association, which was presented at the Savoy Hotel on Wednesday, July 20, disclosed the fact that the Aviation Department has

made steady and continued growth. Of particular interest in this department is the flying map library from which members may hire maps for the route over which they wish to fly. Arrangements have also been concluded with Airwork, Ltd., whereby stocks of these maps are carried both at Heston Airport in this country and Cairo, in Egypt. Not only are these maps used by private owners, but also by those making record attempts, and a very large number of the long-distance record flights made during the past twelve months have used information and maps supplied by the A.A. The A.A. wireless broadcasting station was opened at Heston in September (described in FLIGHT for July 15), and has since been sending out daily weather reports, which have proved of great value to pilots all over the country. Members of the Association staff have also carried out a large number of examinations of aerodrome sites, and the growth of aviation may be gauged from the increase in the number of applications received for reports on sites proposed as aerodromes.

CASE HARDENING

THE Cassel Cyanide Co., Ltd., of Oldbury, nr. Birmingham, which is a subsidiary company of Imperial Chemical Industries, Ltd., has issued a booklet describing the modern methods of case-hardening, and bringing to general notice the particular method of case-hardening usually known as Cyanide-Hardening. The cyanide process differs from pack-hardening in that, instead of employing a compound in the solid state as the means of introducing the carbon, the case-hardening agent is used in the molten state. Results derived from this change, states the booklet, are a saving in labour, uniformity of product, freedom from distortion, exfoliation is eliminated, there is exact temperature control, and, finally, a clean bright finish.

SUMMER THUNDERSTORMS

A VERY useful and interesting pamphlet is the Census of Thunder Storms in the British Isles, 1925-1936, First Annual Report, 1931. Mr. S. M. Bower, of the Royal Meteorological Society, 49, Cromwell Street, S.W.7, points out that this year the expense of this census has been met in part from voluntary contributions from observers and by the sale of the report, but between 1925 and 1931 was financed by him personally. He expects that the results of the census may profitably be utilised in aviation, electrical or transmission engineering as well as in insurance, and he hopes that people interested in these matters will contribute an adequate sum to the funds of the organisation responsible for the collection of the data. The census is the result of the observation of 966 voluntary observers and organisations throughout the British Isles. It is interesting to note that from April-September the areas affected by thunderstorms are almost entirely confined to England itself, leaving Scotland and Ireland comparatively free, whereas from October-March the reverse takes place.

THE AIR EXERCISES

THE narratives printed below give the details of the raids carried out from the evening of Tuesday, 19th, to the morning of Thursday, 21st, when the exercises were brought to an end. It may, however, be interesting to add some comments of our own.

It may be noted that during the first night the A.O.C. Fighting Area had the following fighter squadrons detailed for night patrols, Nos. 3, 32 and 41 F.S. ("Bulldog"), No. 23 ("Bulldog" and "Demon"), No. 1 ("Fury") and No. 56 ("Siskin"). Apparently he became convinced after one night that it was a waste to use the "Fury" and the "Demon" for night work. "Bulldogs" and even "Siskins" are quite fast enough to catch the venerable types of night bomber, "Hyderabad," "Hinaiidi" and "Virginia." Thereafter Nos. 1 and 23 F.S. figured in the day fighting. Instead, No. 19 F.S. ("Bulldog") was put on night duty on Wednesday night. One rather wonders that the second "Siskin" squadron, No. 29 F.S., was not also used for night work. It is not very much use to send up "Siskins" against "Harts," as was done on the morning of Wednesday, 21st. On that occasion Sir Tom Webb-Bowen formed his three "Hart" squadrons (Nos. 18, 12 and 33 B.S.) into a Bomber Wing, and despatched them against the Coventry target. He tried to use the speed of the "Harts" to outflank the defence to the West. Air Vice-Marshal Bowhill received timely and accurate information of this move, but apparently could only spare two fighter squadrons to meet it. Those which he sent were Nos. 43 ("Fury") and No. 29 ("Siskin"), and they attacked the "Hart" Wing over Leamington and Kenilworth. The umpires were doubtless right in judging that the majority of the bombers would have reached their objective. At the same time two other concerted raids were in progress. The two Fairey squadrons Nos. 35 (3F) and 40 ("Gordon") combined against Wantage, and the two "Wapiti" squadrons (Glasgow and Edinburgh) against Henley and Wallingford. There were plenty of fighter squadrons available to deal with them, and both raids suffered severely.

At the outset we remarked in a leading article that the results of the fighting as assessed by the umpires are of very little significance, but that it was a matter of importance that raids should be intercepted. It appears from the final paragraph but one of the narrative that the umpires themselves took this view. The attacks by the fighters were not pushed home. It was the fact of interception which mattered. The casualties awarded probably represent the opinion of the umpires as to the tactical skill of the fighters in delivering their attacks. Surprise should result in bomber casualties. Disregard of the enemy's gunners by fighter pilots would naturally result in casualties being awarded against the fighters. During most of the period the absence of cloud made it hard for the day bombers to escape observation. Where there were none of the Observer Corps on duty, the bombers had to signal their own whereabouts, which eliminated one possibility of human error, and so may have made the task of the defence a trifle more simple. At the same time, when the observers were on duty, their reports were excellent. It is evident that this corps contains the nucleus of an organisation of first-class value. It needs to be expanded, of course; so does every other element in our air-defence system. It is, none the less, a great comfort to know that we are working on the right lines, and that A.D.G.B., while it does not profess to secure London or any other large town from all air attacks, is already in a position to make air raiding such a very costly business to the raiders that they are unlikely to persist in it for long. That was what we succeeded in doing in the last months of the Great War. We hit the raiding "Gothas" so hard that they finally gave up raiding altogether. If there ever is another war, though the attack may be stronger than it was in 1918, our defence will be even stronger in proportion to that attack.

In these exercises the Press has not been permitted to study details. The circumstances of each raid and the conditions which led its interception or the reverse are known only to the staff of A.D.G.B. and of the Areas concerned. Deductions drawn from the narrative of the raids may easily be fallacious. Only a few points seem to be clear, and among them the following seem to emerge. Our bomber squadrons will be found formidable opponents

by any hostile Power, and the standard of our Auxiliary squadrons is not noticeably lower than that of our regulars. Our defence lines are not impenetrable, but they can only be penetrated at very heavy cost.

(5)

Period 18.00 Hours, July 19 to 09.00 Hours, July 20. Daylight Raids.—

1. Operations recommenced at 6 o'clock on Tuesday evening. 2. Weather conditions remained fair in all districts, with varying amounts of cloud mainly above 3,000 ft. Visibility deteriorated from good to moderate generally, and in the early morning ground mist developed locally, continuing for about two hours.

3. A series of Squadron attacks were carried out by Southland day Bomber Squadrons between 6 p.m. and 9 p.m. on Tuesday evening. Three Hart Squadrons, Nos. 18, 33 and 12, one Fairey III F, No. 35, one Gordon, No. 40, and two Wapiti Squadrons, Nos. 602 and 603, were engaged.

4. The Northland frontier was crossed at points between Lyme Regis and Gosport. The Hart Squadrons then proceeded to attack objectives at Coventry and Buckingham, the Fairey III F Squadron objectives at Wantage, the Gordon Squadron objectives at Didcot, and the two Wapiti Squadrons objectives at Wallingford and Henley.

5. As intimation of the raiders was received, the Northland Fighter Squadrons were sent up to intercept them. A Bulldog Squadron, No. 111, intercepted Hart Squadron No. 33 on their way to Buckingham, and shot down one Bomber, the remainder reaching their objectives. The other two Hart Squadrons, Nos. 18 and 12, raiding Coventry, reached their objectives and returned without being molested.

6. The Fairey III F Squadron, No. 35, raided Wantage and was not intercepted.

7. The Gordon Squadron, No. 40, was once more successful in penetrating the defensive during its raid on Didcot, and was not intercepted.

8. One of the Wapiti Squadrons, No. 602, was intercepted and attacked three times on its way to Wallingford, twice by No. 1 Fighter Squadron and once by No. 19 Fighter Squadron. As a result, four Bombers were shot down and two Fighters destroyed. The other Wapiti Squadron, No. 603, carried out a raid on Henley without being intercepted.

9. Out of seven day Bomber raids during this period, five were not intercepted.

Night Raids.—10. From 10.10 p.m. on Tuesday evening, operations by Southland night Bombers commenced. These raids were carried out by single aircraft at various time intervals up to 2.45 a.m. on Wednesday, July 20.

11. Virginias of No. 7 Squadron attacked objectives at Coventry and Wallingford. Two aircraft of these Squadrons were shot down on their way in to Coventry by Fighters of No. 56 Squadron, but accounted for one Fighter. This Squadron's raids on Wallingford were not intercepted.

12. Four Virginias of No. 58 Squadron attacked objectives at Coventry also. Only one reached the objective, however, one being intercepted and shot down by Fighters of No. 41 Squadron, another was shot down by Fighters of No. 56 Squadron, and the fourth returned owing to cloud conditions. Five Virginias of this Squadron also carried out raids on Wallingford, three of which reached their objective, one was recalled, and the fifth failed to reach the objective owing to low cloud.

13. Eight Virginias of No. 9 Squadron carried out attacks on objectives at Wantage, only one of which failed. They were not intercepted at any time.

14. Six Hinaiidis of No. 10 Squadron carried out raids on objectives at Milton. Of these, one was shot down by Fighters of No. 3 Squadron before reaching the objective, and the results of two others were negative.

15. Four Hinaiidis of No. 99 Squadron carried out raids on Buckingham. One was engaged by a Fighter of No. 41 Squadron before reaching the objective and in the ensuing combat both aircraft were shot down. Another Hinaiidi reached the objective, whilst the results of the remaining two attacks were negative.

16. Three Virginias of No. 502 Squadron carried out raids on Henley. Two of these were engaged by Fighters of Nos. 41 and 32 Squadrons, both before and after reaching their objectives, and were shot down together with one Fighter of No. 32 Squadron. The third successfully attacked the objective.

17. Five Hyderabads of No. 503 Squadron carried out raids on Henley also, and of these four were attacked by Fighters of Nos. 32 and 41 Squadrons on the return journey. Three Hyderabads and one Fighter of No. 41 Squadron were shot down.

18. From 4 a.m. to 9 a.m. to-day, Wednesday, Southland resumed its raids by day Bombers. The raids were carried out on objectives at Wantage, Wallingford, Didcot and Henley. Several combats with defending Fighters occurred, the results of which are now being assessed.

(6)

Amplifying Phase 3.—Period 04.00 Hours-08.00 Hours, July 20, 1932.—

1. The weather conditions during the period under review were generally favourable, and flying conditions were good, although there was early morning mist.

2. The Air Officer Commanding, Southland, varied his form of attack by directing three Squadrons of Harts to cross the frontier at the same time and to attack simultaneously objectives at Wantage, Milton and Wallingford.

3. These Squadrons all reached their objective, though one of them was intercepted just before it reached its objective at Wallingford.

4. The remaining Southland Squadrons carried out individual Squadron attacks on Northland objectives. Generally speaking, the raiding Squadrons were successfully engaged by the defending Fighters. Of eight raids, one only, No. 12 (Hart) Squadron, succeeded in returning without having been attacked.

5. The raiders suffered a total loss of 15 aircraft, i.e., over 20 per cent. of their raiding strength. In this fighting the defending Squadrons lost 9 aircraft, i.e., 17 per cent. of their attacking strength.

6. No. 35 Squadron (Fairey III F) was attacked three times. Nos. 40 (Gordon), 33 (Hart) and 18 (Hart) Squadrons were all engaged twice—on every occasion by Fighter Squadrons at full strength of nine aircraft.

7. The results of raids during this period have now been assessed and actual details of the raids, combats and casualties, grouped according to targets, are as follows:—

(a) *Wantage.*—Nine Harts of 12 Squadron crossed the frontier at Hurst Castle and reached the objective. They were intercepted on their return over Abingdon by two Furies of No. 43 Squadron, one of which was destroyed.

Ten Harts of No. 12 Squadron entered the operational area at Lee-on-Solent, attacking the objective at 08.12 and returned without molestation.

(b) *Milton.*—No. 35 Squadron (ten Fairey III F's) came in over Portsmouth and was intercepted by nine Furies of 43 Squadron near Wallingford. Two Bombers and one Fighter were destroyed. They were

intercepted on the return journey by nine Bulldogs* of No. 29 Squadron and later on by nine Bulldogs of No. 111 Squadron. Two further Bombers were shot down.

No. 40 Squadron (ten Gordons) crossed the frontier over Portsmouth and were intercepted before reaching the objective by nine Bulldogs of No. 111 Squadron over Newbury.

One Bomber and one Fighter were destroyed. The Squadron reached the objective, but were intercepted again on the way out by nine Bulldogs of No. 54 Squadron over Pangbourne and lost another Gordon.

Ten Harts of No. 33 Squadron came in over Lee-on-Solent reaching the objective without being attacked. Immediately after dropping their bombs they were intercepted by nine Furies of No. 43 Squadron and lost two Bombers as against one aircraft lost by the Fighters. They were intercepted again by nine Furies of No. 1 Squadron near Wallingford, the resulting casualties being two more Bombers and one Fighter.

(c) *Henley*.—The objective was reached by eight Wapitis of No. 602 Squadron, who came in over Hayling Island. They were intercepted on their way out by six Bulldogs of No. 23 Squadron over Hook and lost one aircraft.

No. 603 Squadron (nine Wapitis) also came in over Hayling Island, making for Henley. They reached the objective and were intercepted at Wanborough on their way out by three Fighter Harts of No. 23 Squadron, who shot down one Bomber.

(d) *Wallingford*.—Nine Harts of No. 18 Squadron entered the operational area at Lee-on-Solent and were intercepted just before reaching their target by nine Furies of No. 43 Squadron. The resulting casualties were one Bomber and one Fighter destroyed. On the return journey they were again intercepted, this time by nine Furies of No. 1 Squadron and lost two more Bombers; three Furies were also destroyed.

(7)

18.00.22.00 Hours, July 20.—1. Towards evening the weather deteriorated considerably and an area of low cloud and rain travelled from north-north-west to south-south-east across the area of operations. Later the weather conditions improved generally.

2. Southland renewed its attacks on the Northland objectives crossing the frontier between 18.00 and 22.00 hours.

3. Reports so far received show that No. 12 Squadron (Hart), No. 35 Squadron (Fairley III F), and No. 602 Squadron (Wapiti), reached their objectives, the first two Squadrons attacking Buckingham and the last Milton. Owing to bad weather, No. 18 Squadron (Hart) was unable to press home its attack on Wantage.

4. Nos. 33 (Hart), 40 (Gordon), 603 (Wapiti) Squadrons are attacking Coventry, Henley and Wallingford targets respectively. A number of combats have been reported as having taken place, but it is not yet possible to form an opinion as to the results.

(8)

Period 18.00 Hours, July 20, to Conclusion of Operations, 09.00 Hours, July 21.—1. Operations were renewed at 6 o'clock last night. Flying conditions generally were favourable, though an area of low cloud and rain drifted across the operational area early last night.

Daylight Raids. Evening, July 20.—2. The objective at Buckingham was attacked by two Squadrons, one of 9 Harts, No. 12 Squadron, and the other eight Fairley III F's of No. 35 Squadron. The former crossed the frontier at Poole, and reached the objective without being attacked. On the return journey they were intercepted by No. 23 Fighter Squadron, two Fighters and two Bombers being shot down. No. 35 (Bomber) Squadron entered the operational area at Shoreham and were intercepted by Nos. 1 and 25 Fighter Squadrons on their way to the target; four Bombers and one Fighter of No. 1 Squadron were shot down. No interception took place on the return journey.

3. Nine Harts of No. 18 (Bomber) Squadron crossed the frontier at Lulworth at 18.30 hours, intending to attack the objective at Wantage, but had to return owing to low cloud.

4. No. 33 (Bomber) Squadron (nine Harts) came in over Poole and were attacked by No. 43 Fighter Squadron on their way to the objective at Coventry. Resulting casualties were two Bombers and one Fighter.

5. Nine Gordons of No. 40 (Bomber) Squadron came in over Worthing, with the object of attacking Henley. They did not, however, reach their objective.

6. Two auxiliary Squadrons, Nos. 602 and 603, the former with seven Wapitis and the latter with nine, crossed the frontier at Littlehampton at 18.00 hours. No. 602 Squadron attacked Milton but before reaching their objective they were engaged by No. 19 (Fighter) Squadron, who shot down one Bomber. No. 603 Squadron made for the objective at Wallingford, which they reached without interception. On the return journey, however,

they were attacked by No. 19 (Fighter) Squadron, and in the ensuing combat one Bomber and one Fighter were shot down.

Night Raids.—7. Eight Virginias of No. 58 (Bomber) Squadron raided the targets at Wallingford, Henley and Buckingham at various times between 12.20 a.m. and 3 a.m. No. 41 (Fighter) Squadron successfully engaged six of these Bombers whilst No. 32 (Fighter) Squadron engaged one. Four Virginias were shot down; Nos. 41 and 32 (Fighter) Squadrons each losing one Fighter.

8. Eight Virginias of No. 7 (Bomber) Squadron also attacked the same target during the same period. The aircraft of this Squadron were also heavily engaged by Fighters of No. 41 Squadron and lost four Bombers. Four Bulldogs were also shot down.

9. No. 9 Squadron (eight Virginias) attacked Milton and Wantage at intervals between midnight and 2 a.m. They came in by way of Lulworth and were intercepted by Fighters of Nos. 3 and 41 (Fighter) Squadrons. Two Bombers and two Fighters were destroyed in combat.

10. Coventry was attacked by six Hinaidis of No. 10 (Bomber) Squadron between midnight and 2 a.m. No. 56 (Fighter) Squadron engaged three of these Bombers whilst No. 3 Squadron engaged one. In the resulting combat No. 10 (Bomber) Squadron lost two Bombers and No. 56 one Fighter.

11. Three Hinaidis of No. 99 (Bomber) Squadron attacked objectives at Buckingham. They all reached the objective but were intercepted by Fighters of Nos. 56, 41 and 32 (Fighter) Squadrons on their return. The losses were two Bombers and three Fighters.

12. No. 502 Squadron (five Virginias) came in over Portsmouth to attack Wallingford and Henley. Several combats took place with Fighters of Nos. 41, 32, 56 and 19 (Fighter) Squadrons. Three Bombers and three Fighters were destroyed. Five Hyderabad of No. 503 (Bomber) Squadron crossed the frontier at St. Catherine's Point, to attack objectives at Abingdon and Wantage. Only two of these Bombers reached their objective, the remaining three returning owing to bad weather. Both Bombers which reached the objective were shot down on their return journey, one Fighter of No. 32 Squadron also being destroyed.

Daylight Raids. July 21.—13. As previously described, the Air Officer Commanding, Southland, yesterday morning delivered his massed attack against the centre of the Northland Front, with a concerted raid of three Hart Bomber Squadrons, separate targets being allotted to each Squadron.

14. This morning, however, he altered his tactics and launched a complete Wing raid of three Hart Bomber Squadrons against the Western Sector of the Northland Defence system. Coventry was the sole objective allotted to this attack. The three Squadrons, Nos. 12, 18 and 33, joined forces at a rendezvous off the coast, near Christchurch, Hants, and setting a course for Trowbridge, Wilts, endeavoured by keeping well to the westward to outflank the Northland Defences.

15. The Northland Commander acting on reliable and early information of this attack, prepared counter-measures. This envisaged the despatch of Nos. 43 and 29 (Fighter) Squadrons to intercept the massed Southland attack. Contact was gained with the raiders and this led to a considerable air battle over Leamington and Kenilworth, in which three Fighters and three Bombers were lost. In spite of this, twenty-four of the Southland Bombers were successful in reaching the objectives at Coventry. On the return journey the Bombers were engaged over Newbury by a defence Fighter Squadron, resulting in a further three Fighters and three Bombers being shot down.

16. Two other concerted raids were launched by Southland, No. 35 (Fairley III F) and No. 40 (Gordon) Squadrons against Wantage and Nos. 602 and 603 (Wapiti) Squadrons against Henley and Wallingford, respectively. Both raids were encountered by Northland Fighters, Fairleys and Gordons suffering six casualties and the Wapitis three. The Fighters lost two aircraft only.

17. The operations were concluded on the termination of the daylight phase described.

Casualties.—In practically all combats in which casualties have been apportioned to one side or the other, the Empire Staff has laid greater stress upon the fact that interception took place than upon the actual duration of the resulting combats. The Fighters, therefore, in the majority of cases, have carried out one attack only on each hostile Bomber formation, or individual encounter. Had the attacks been repeated up to the number which the amount of ammunition assumed to have been carried by the Fighters would have permitted, the losses amongst the Bombers would have been appreciably greater.

Observation Corps.—Throughout the period of the Exercises the civilian Volunteer Observation Corps has operated each evening from 7 p.m. until midnight. The accuracy with which the approach of the Southland raiding aircraft has been reported by this organisation has been most marked, and has proved once more to be a very material factor in assisting the Air Officer Commanding, Northland, to intercept the enemy raiders.

* [No. 29 (Fighter) Squadron is equipped with Siskins, not Bulldogs.—ED.]

THE ROYAL AIR FORCE

London Gazette, July 19, 1932.

General Duties Branch

J. J. Zwarenstein is granted a permanent commn. as Pilot Officer with effect from July 11 and with seny. of July 11, 1931. The foll. Pilot Officers on probation are confirmed in rank:—T. G. Lovell-Gregg (June 30); D. W. Reid (July 13). The foll. Pilot Officers are promoted to rank of Flying Officer:—J. C. Macdonald, W. S. Reed, J. S. Sabine (June 20); R. G. C. Arnold, R. J. Bennett, G. T. Jarman, R. I. R. Winn (June 29); E. R. S. Johnston (July 5).

F/O. J. W. Martin is transferred to Reserve, Class C (June 4) (substituted for Gazette June 14). The foll. Flying Officers are transferred to Reserve (July 18):—CLASS A.—F. T. K. Bullmore, D. J. Hughes-Morgan, M. G. Sedorski, G. E. E. Singleton. CLASS C.—P. G. J. Atkinson, C. E. V. L'E. Feasy, K. F. Jones, A. P. Miller, O. G. Williams.

Wing. Com. G. B. Dacre, D.S.O., is placed on half-pay list, Scale A, from May 29 to June 29, inclusive; Sqd. Ldr. (now Wing Com.) R. H. G. Neville, O.B.E., M.C., is placed on half-pay list, Scale A, from June 20 to July 3, inclusive; F/O. F. W. Wrench is placed on retired list (July 20); F/O. H. J. Cross relinquishes his short service commn. on account of ill-health (July 18); F/O. G. M. Williams relinquishes his short service commn. on account of ill-health (July 20).

Stores Branch

Sqd. Ldr. W. G. MacD. Nicholl is placed on half-pay list, Scale A (July 5).

Dental Branch

F/O. F. B. Sumerling, B.D.Sc., is promoted to rank of Flt. Lt. (July 9).

ROYAL AIR FORCE RESERVE. RESERVE OF AIR FORCE OFFICERS

General Duties Branch

H. G. Goddard is granted a commn. in Class AA (ii) as a Pilot Officer (July 4). The foll. are granted commns. in Class AA (ii) as Pilot Officers on probation:—

A. V. Lawes (July 1); S. G. Birch, B. E. Knight (July 4); J. A. Tinne (July 5); W. H. Salt (July 6).

The foll. Flying Officers are transferred from Class A to Class C:—A. T. E. Eadon (July 2); H. A. Boniface (July 7). Flt. Lt. H. G. Loch is transferred from Class C to Class A (April 29); P/O. on probation H. G. Watkins is transferred from Class AA (ii) to Class C (July 10). *Gazette* July 12 concerning P/O. T. C. Wallace is cancelled. F/O. H. L. R. Gough (Capt., Royal Artillery, R.A.R.O.) relinquishes his commn. on completion of service (July 14); F/O. F. R. Offord (Lieut. Royal Munster Fus., R.A.R.O.) relinquishes his commn. on completion of service and is permitted to retain rank of Flt. Lt. (Sept. 6, 1931); the commn. of P/O. on probation M. C. Rigby is terminated on cessation of duty (June 21).

Stores Branch

Sqd. Ldr. E. D. Galloway is transferred from Class C to Class B (June 17).

SPECIAL RESERVE

General Duties Branch

The foll. are granted commns. as Pilot Officers on probation:—T. H. Clarke (June 11); H. Baker (June 29).

Medical Branch

F/O. D. S. Buchanan, M.A., M.B., Ch.B., is promoted to rank of Flt. Lt. (Feb. 12).

AUXILIARY AIR FORCE

General Duties Branch

No. 603 (CITY OF EDINBURGH) (BOMBER) SQUADRON.—P/O. I. Kirkpatrick is promoted to rank of F/O. (July 7).

Erratum

In *Gazette* July 12 concerning F/O. A. T. G. Thomas, M.B., B.S. For July 7, 1931, read July 7, 1932.

AIRCRAFT COMPANIES' STOCKS AND SHARES

DURING the past month the industrial section of the Stock Exchange has exhibited two distinct features, both initiated by the stimulating influence of the War Loan conversion scheme. At the outset a sharp advance was established by ordinary shares, the greater part of which has been maintained despite subsequent profit-taking, hopes attaching to the Ottawa Conference having proved a steady-ing factor. Secondly, debentures and preference shares, where the interest is well covered by net profits, have been in good demand throughout and have been marked up sharply to accord with the reduced yield on British Govern-ment stocks. Shares of companies operating in the aircraft and associated industries have reflected the foregoing general tendency, but movements in ordinary shares have been within somewhat narrow limits, the contingency of a wider measure of international disarmament having tended to lead investors to follow a waiting policy for the time being. On balance for the month Fairey Aviation show an improvement to 11s. 10½d., at which the gross yield is on the large side. The latter may bring in support for the shares as dividend possibilities come under discussion in the market. It has been mentioned in these notes on a previous occasion that well over 20 per cent. net could have been paid on the ordinary shares for the past year if profits had been fully distributed. As it is not the company's custom to pay interim dividends, the present price of the shares may be regarded as carrying the whole of the dividend to be paid for the year. De Havilland have not been particularly active and are slightly down on the month. Imperial Airways have been a good feature on continued reports that better business is being experi-enced, and have changed hands at around 16s. 6d. and 16s. 9d., which compares with 14s. 6d. to 15s. 9d. a month ago. There are hopes in the market that a modest increase

on the previous year's 3 per cent. dividend may be pos-sible. Handley Page preference have shown some recovery from their set-back on the results. At the meeting the chairman stated that the lower profits were not due to a falling-off in business, but chiefly to contracts with Imperial Airways having proved unprofitable, as they took longer to complete than had been anticipated. D. Napier & Son issues have been more steady and the 7½ per cent. prefer-ence shares have been in strong request with a rise to 20s., their par value, which reflects the increased demand for preference shares with good margin. Rolls-Royce, British Aluminium, Dunlop Rubber and Triplex Glass are among equity shares which have risen in response to the increased investment demand. Vickers 5 per cent. tax-free prefer-ence shares have been among the preference issues in re-quest. Joseph Lucas have had a good rise on the month, the market hoping that the dividend may be maintained at 20 per cent. "Shell" and other oil shares have risen sharply, the movement being stimulated by news of the agreement on marketing reached at the conference in Paris.

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Air Service Training

THE A.S.T. school at Hamble will be closed from July 31 to August 2. This announcement is made, as owing to the recent large number of visitors, it is felt that others might inadvertently make fruitless journeys to visit the school between these dates, unless they know the school is closed. The recently established course designed for those who wish to make aviation their pro-fession has already attracted a large amount of interest, and A.S.T. have received many inquiries from men wish-ing to undergo this training. Of particular attraction is the course for the W/T Air Operator's certificate, as it is realised that the possession of this certificate is a valuable qualification to a commercial pilot. That the flying train-ing at the school satisfies the most captious critics is shown by the fact that Sec. Lt. Rasananda, a Siamese officer who completed a blind flying course two months ago, has now been sent back to the school by his Govern-ment for a course of advanced dual instruction on various types of aircraft.

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PUBLICATIONS RECEIVED

Technical Notes of the U.S. National Advisory Committee for Aeronautics : No. 414. *Considerations of Air Flow in Combustion Chambers of High-speed Compression-ignition Engines.* By J. A. Spanogle and C. S. Moore. April, 1932. No. 415. *Preliminary Investigation of Rolling Moments Obtained with Spoilers on Both Slotted and Plain Wings.* By F. E. Weick and C. J. Wenz-inger. April, 1932. No. 416. *Characteristics of Two Sharp-nosed Airfoils Having Reduced Spinning Tendencies.* By E. N. Jacobs. April, 1932. No. 418. *Compression-ignition Engine Tests of Several Fuels.* By J. A. Spanogle. May, 1932. No. 422. *The Aerodynamic Characteristics of a Model Wing Having a Split Flap Deflected Downward and Moved to the Rear.* By F. E. Weick and T. A. Harris. May, 1932. U.S. National Advisory Committee for Aeronautics, Washington, D.C., U.S.A.

Aeronautical Research Committee Reports and Memoranda : No. 1377. *Application of Goldstein's Airscrew Theory to Design.* By C. N. H. Lock. November, 1930. Price 1s. 3d. net. No. 1477. *Thrust Integrating Tubes : Wind Tunnel Experiments.* By C. N. H. Lock, F. C. Johansen and H. L. Nixon. August, 1931. Price 1s. 3d. net. No. 1457. *Two Reports on Tail Buffeting.* February, 1932. Price 2s. 3d. net. London : H.M. Stationery Office, W.C.2.

Kronfeld on Gliding and Soaring. By Robert Kronfeld. London : John Hamilton, Ltd. Price 21s. net.

La Climatologia dell' Alta Atmosfera. By F. Eredia. Ministro dell' Aero-nautica, Rome.

Gas Starter Systems for Aero-Engines. Air Publication 1181. London : H.M. Stationery Office, W.C.2. Price 2s. net.

Il Vola a Vela. By Vittorio Bonomi and Camillo Silva. Aeronautica Bonomi, Via Jesu 6, Milan.

Blind Flight in Theory and Practice. By Maj. W. C. Ocker and Lt. C. J. Crane. Naylor Printing Co., San Antonio, Texas, U.S.A. Price \$3.00.

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AERONAUTICAL PATENT SPECIFICATIONS

Abbreviations : Cyl. = cylinder ; i.c. = internal combustion ; m. = motors (The numbers in brackets are those under which the Specification will be printed and abridged, etc.).

APPLIED FOR IN 1931

Published July 28, 1932

- 10,261. SOC. INDUSTRIELLE DES PROCÉDES W. A. LOTH. Electromagnetic signalling for aerodromes. (375,887.)
- 12,743. E. OEHMICHEN. Control device for aircraft. (375,931.)
- 15,193. G. DE HAVILLAND AND DE HAVILLAND AIRCRAFT CO., LTD. Aircraft. (375,954.)
- 17,511. MACTAGGART SCOTT & CO., LTD., and C. C. MITCHELL. Aircraft launching apparatus. (375,983.)
- 29,270. IRVING AIR CHUTE CO., INC. Parachute rip-cord apparatus. (376,126.)

APPLIED FOR IN 1932

Published July 21, 1932

- 4,223. G. L. R. J. MESSIER. Construction of aeroplanes. (375,733.)
- 7,208. G. P. HERRICK. Aerofolls. (375,327.)
- 9,782. H. HEIN. Landing-devices for aircraft. (375,746)

Name.	Class.	Nominal Amount of Share.	Last Annual Dividend.	Current Week's Quotation.
Anglo-American Oil ..	Deb.	Stk.	5½	103
Armstrong Siddeley Develop. ..	Cum. Pref.	£1	6½	13/9
Birmingham Aluminium Castg. ..	Ord.	£1	5	18/9
Booth (James), 1915 ..	Ord.	£1	15	42/-
Do. do. ..	Cum. Pref.	£1	7	24/-
British Aluminium ..	Ord.	£1	5	21/6
Do. do. ..	Cum. Pref.	£1	6	21/3
British Celanese ..	Ord.	10/-	Nil	6/1½
British Oxygen ..	Ord.	£1	3	12/6
Do. do. ..	Cum. Pref.	£1	6½	21/3
British Piston Ring ..	Ord.	£1	10	25/-
British Thomson-Houston ..	Cum. Pref.	£1	7	26/-
Brown Brothers ..	Ord.	£1	10	26/3
Do. do. ..	Cum. Pref.	£1	7½	26/3
Dick (W. B.) ..	Cum. Pref.	£10	5	111/3
De Havilland Aircraft ..	Ord.	£1	5	13/6
Dunlop Rubber ..	Ord.	c	Nil	11/6
Do. do. ..	"C" Cum. Pref.	16/-	10	12/9
En-Tout-Cas (Syston) ..	Def. Ord.	1/-	Nil	1/-
Do. do. ..	Ptg. Pfd. Ord.	5/-	8	2/6
Fairey Aviation ..	Ord.	10/-	10*	11/10½
Do. do. ..	1st Mt. Deb.	Stk.	8	110
Firth (T.) & John Brown ..	Cum. Pref.	£1	6D	6/-
Do. do. ..	Cum. Pref.	£1	5*D	4/6
Ford Motor (England) ..	Ord.	£1	Nil	18/-
Fox (Samuel) ..	Mt. Ptual.	Stk.	5	74½
Goodyear Tyre & Rubber ..	Deb.	Stk.	6½	106xd.
Handley Page ..	Ptg. Pref.	8/-	12½	6/8
Hoffmann Manufacturing ..	Ord.	£1	Nil	15/1½
Do. do. ..	Cum. Pref.	£1	7½	19/-
Imperial Airways ..	Ord.	£1	3	16/6
Kayser, Ellison ..	Ord.	£5	Nil	55/-
Do. do. ..	Cum. Pref.	£5	6	72/6
Lucas (Joseph) ..	Ord.	£1	20	62/6
Napier (D.), & Son ..	Ord.	5/-	Nil	3/-
Do. do. ..	Cum. Pref.	£1	7½	20/-
Do. do. ..	Pref.	£1	8	10/-
National Flying Services ..	Ord.	2/-	Nil	-/3
Petters ..	Ord.	£1	Nil	15/-
Do. do. ..	Cum. Pref.	£1	7½	15/-
Roe (A. V.) (Cont. by Arm- strong-Siddeley Devel., q.v.) ..	Ord.	£1	—	—
Rolls-Royce ..	Ord.	£1	10	36/9
Smith (S.) & Sons (M.A.) ..	Def. Ord.	1/-	Nil	-/9
Do. d. ..	Pt. Pfd. Ord.	£1	7	10/-
Do. do. ..	Cum. Pref.	£1	7½	12/6
Serck Radiators ..	Ord.	£1	15	29/6
"Shell Transport & Trading ..	Ord.	£1	7½*	40/-
Do. do. ..	Cum. Pref.	£10	5	£11½
Triplex Safety Glass ..	Ord.	£1	10	34/-
Vickers ..	Ord.	6/8	5	6/4½
Do. do. ..	Cum. Pref.	£1	5*	17/6
Vickers Aviation (Cont. by Vickers, q.v.) ..	—	—	—	—
Westland Aircraft (Branch of Petters, q.v.) ..	—	—	—	—

* Dividend paid tax free. c £1 unit of stock. d Last xd. on March 19.